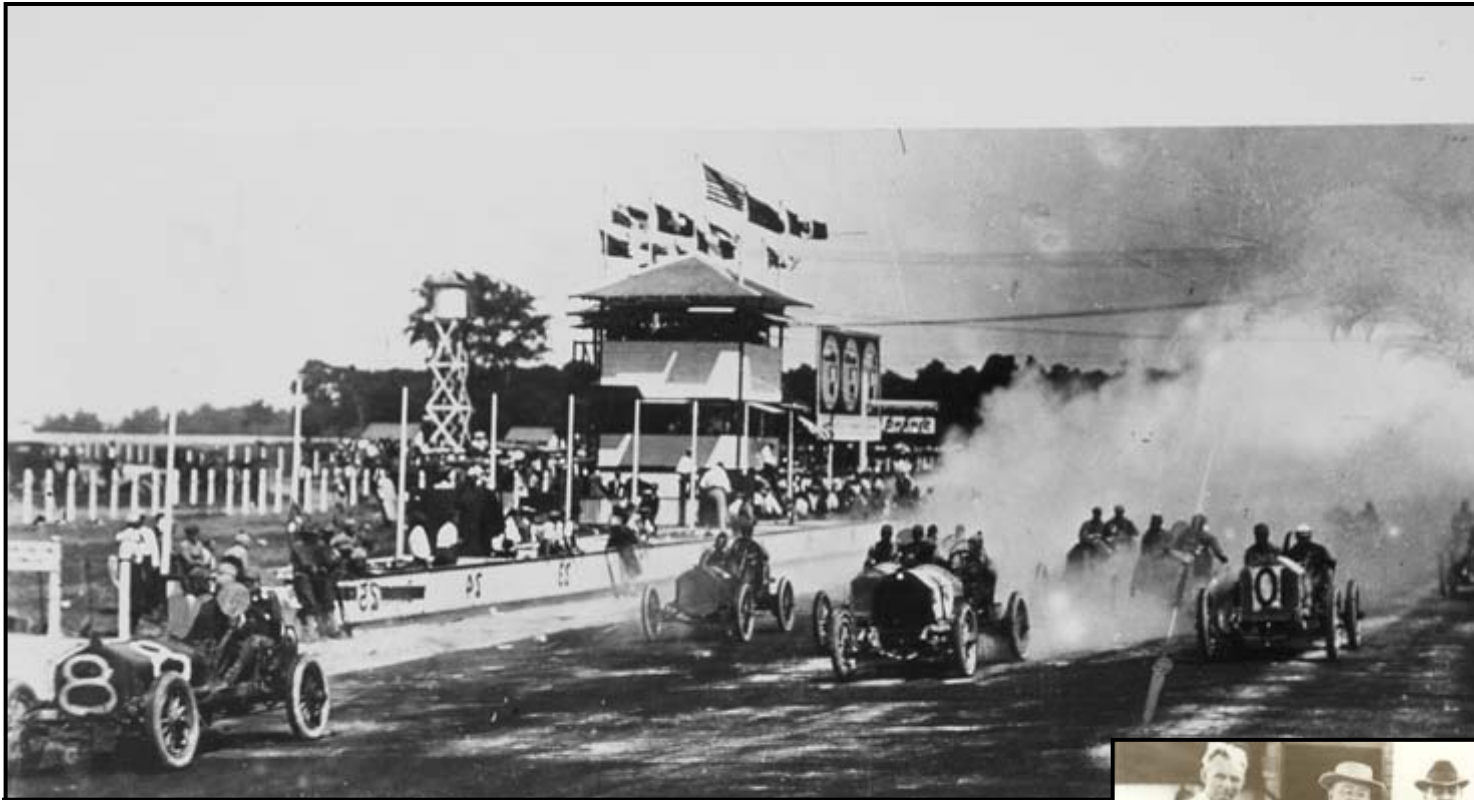


A look back at development of the Model 250 Turbine Engine



Rolls-Royce

Allison: how it all got started



With the growth of the American auto industry, auto racing came to the American Midwest in a big way.

Jim Allison embraced this dynamic new industry and in 1909 co-founded the Indianapolis Speedway Company, which built the famous brickyard 500.



Rolls-Royce

Allison Engineering Co: the early days



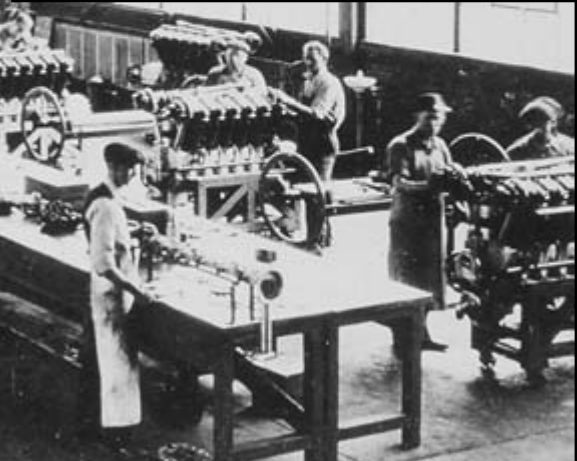
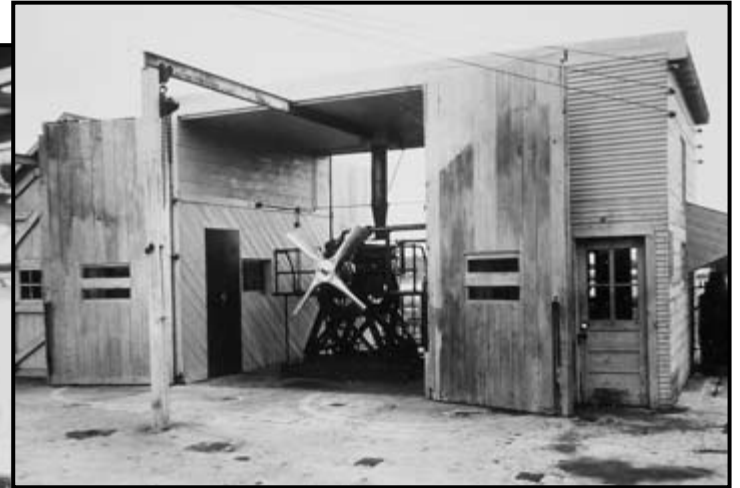
Allison Engineering Company was started in 1915 developing improvements for race car engines and gained notoriety as a high quality specialty shop.

On April 17th 1917, the day after America entered WWI, Jim Allison told his crew to “stop working on cars but keep our men. Go out and get war orders; take any jobs, especially the ones other fellows can’t do!”



Rolls-Royce

Allison: the early days



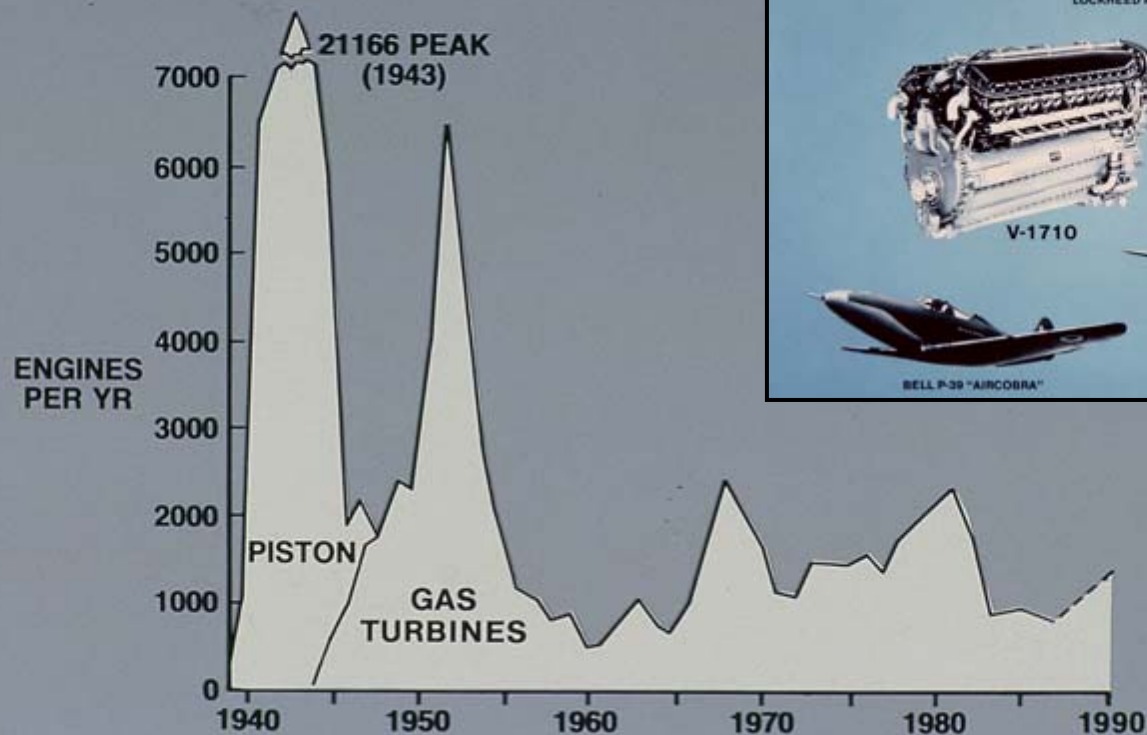
Allison Engine Company got its start in aviation overhauling Liberty engines during WWI



Rolls-Royce

Allison: a major wartime engine producer

ALLISON - A MAJOR PRODUCER OF GAS TURBINE ENGINES

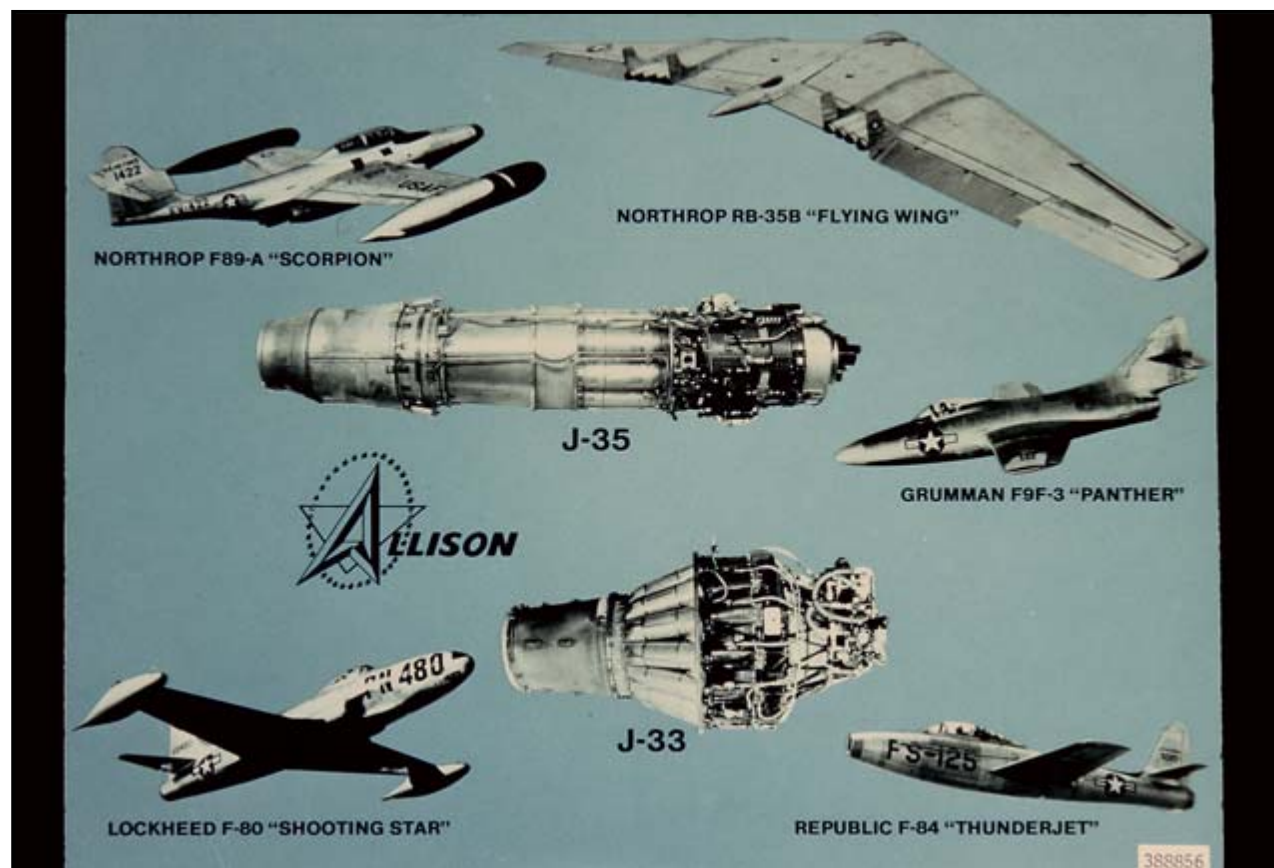


During WWII, Allison Division of GM gained fame with the V1710 water cooled in-line fighter engine, which saw a peak production rate of 21,166 engines in 1943.

Allison enters the jet age

Allison Division of GM entered the jet age in the mid 1940's with the J33 & J35 turbojet engines. Ultimately 15,525 J33 engines rated at 4,000 lbs thrust were built. They carried an initial TBO of just 50 hours but in 1947, the J33 completed the first ever turbine engine 150 hr qualification test.

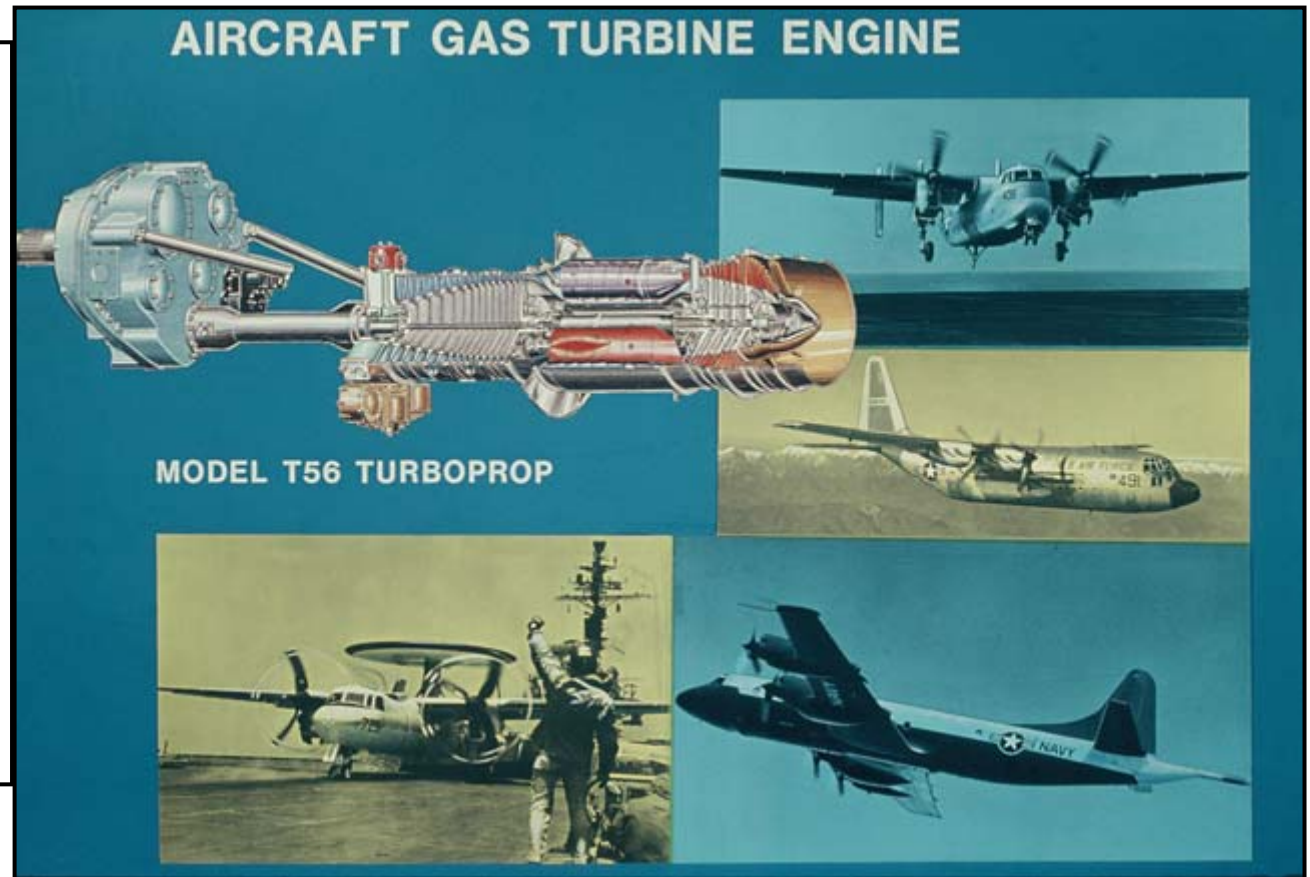
In August of 1951, the J33 became first jet engine to operate 1000 hours before overhaul.



Allison develops large turboprop engine

One of the most famous and widely used Allison engines is the T56 Turboprop. Developed in the mid 1950's, variants of this workhorse are still widely used around the world.

In 1956, during flight test of the Hydromechanical fuel control onboard a Lockheed C-130A Hercules, the Allison flight crew set an unofficial altitude record by performing a locked throttle climb to 40,400 feet.



Rolls-Royce Model 250 Turbine Engine

One of the most successful small turbine engines ever developed.

First flown in the early weeks of 1961, it is now nearing its 50th birthday and continues at a healthy production rate.

The Model 250 engine portfolio of applications covers over 130 different aircraft types, 80 of which are still flying today.

At the peak of production in 1970, a phenomenal 200 Model 250 engines were built every month.

More than 30,000 Model 250 engines have been built over the years with nearly 17,000 still in service today.



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

Originally designed to meet a military requirement for a 250 shp light turbine, the Model 250 has gone on to spawn a range of both military and civil variants with power ratings up to 715 shp.



Rolls-Royce

Model 250 Diverse Mission Requirements

Model 250 powered helicopters are used in virtually every type of mission.

- Airborne Law Enforcement
- Aero Medical
- News Gathering
- Border Patrol
- Corporate Transportation
- Logging & Timber Support
- Crop Dusting
- Power Line Patrol & Maintenance
- Offshore Oil & Gas Support
- Airborne Seismic Survey
- Mining Support
- Pilot Training
- Mountain Rescue
- Tour Operators
- Military Operations



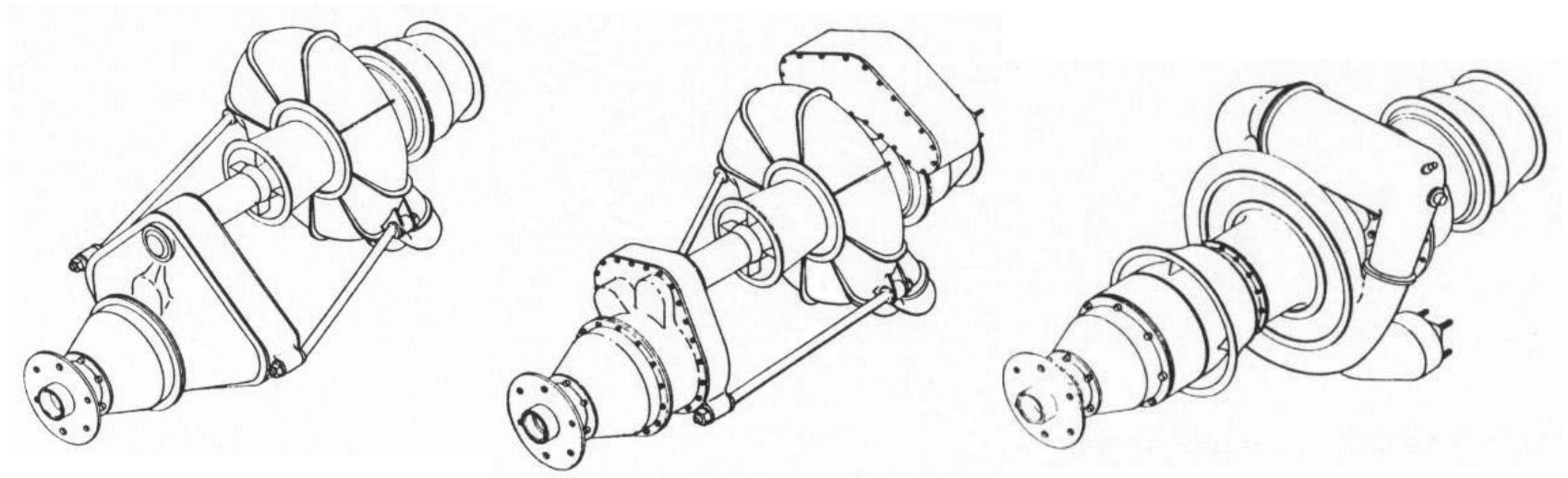
Rolls-Royce

Genesis of the Model 250 Engine

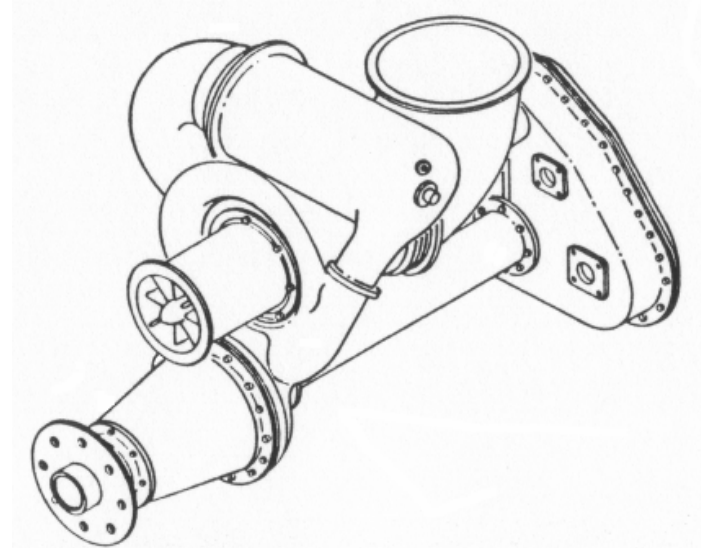
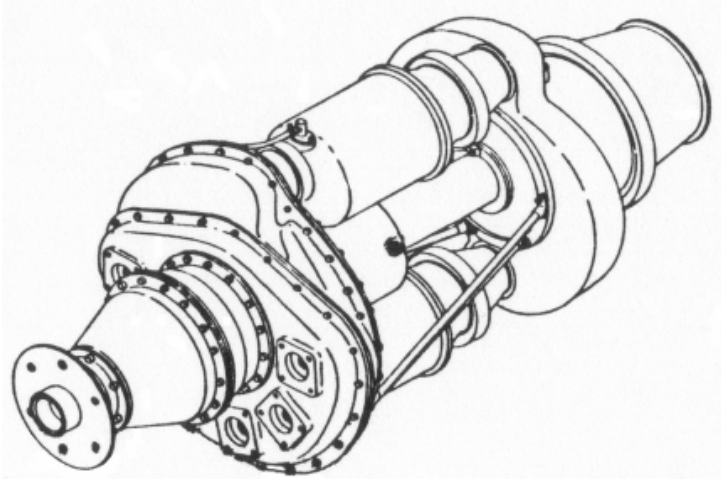
In 1957 the US Army saw a need for a new Light Observation Aircraft (LOA) powered by a turbine engine to replace the Cessna O-1A Bird Dog.

In 1958, the Army selected General Motors, Detroit Diesel Allison Division to develop this new light turbine engine.

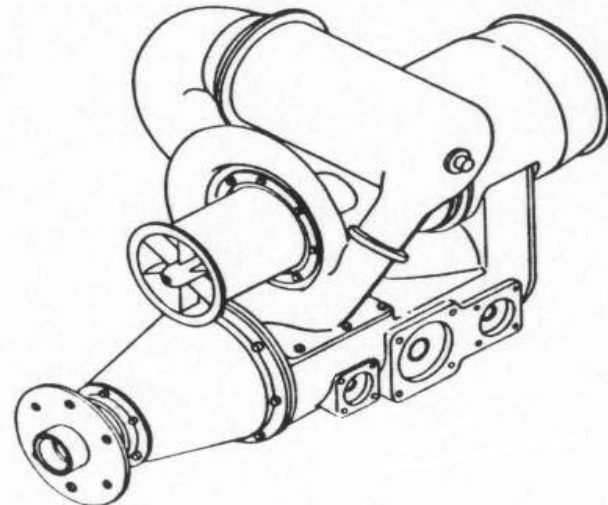
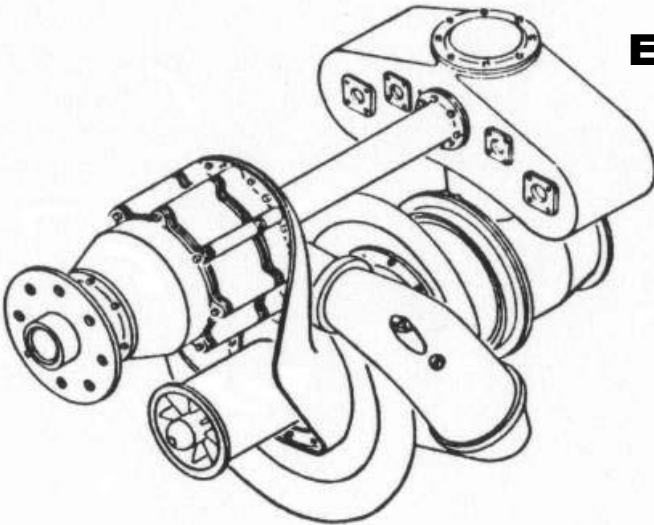
The Army was unsure whether to specify a fixed or rotary wing platform so the Allison design concept considered both types.



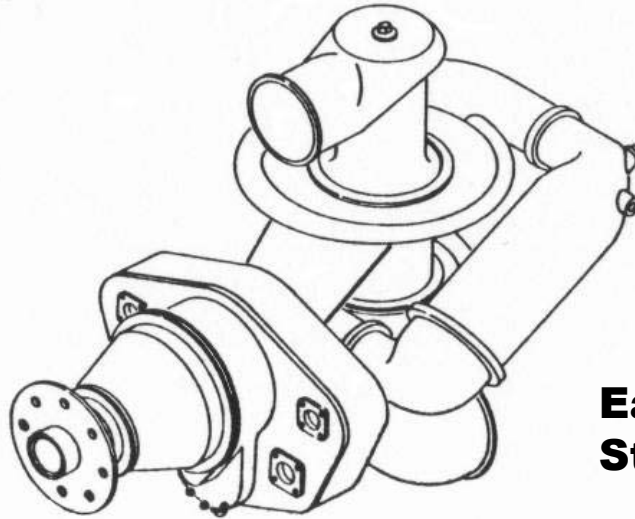
Genesis of the Model 250 Engine



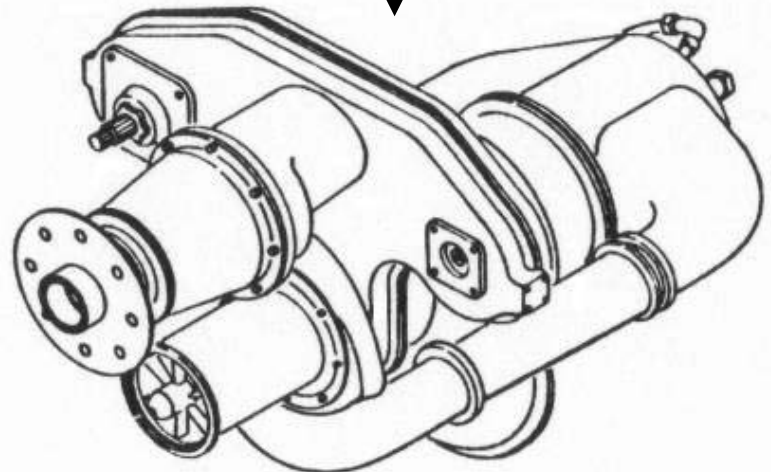
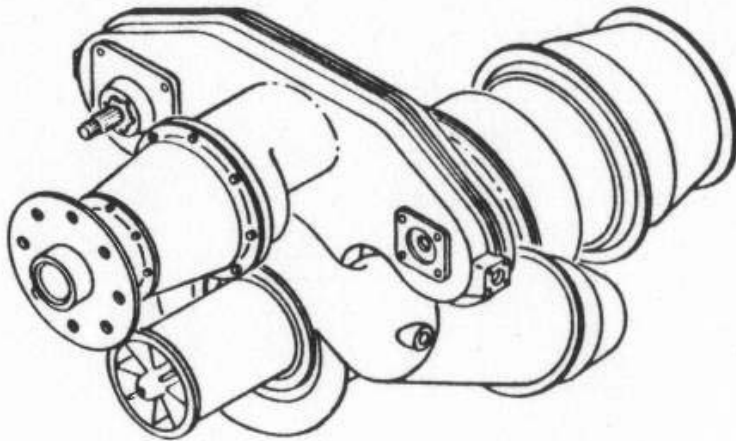
Early Evolving M250 (T63) design concepts



Genesis of the Model 250 Engine

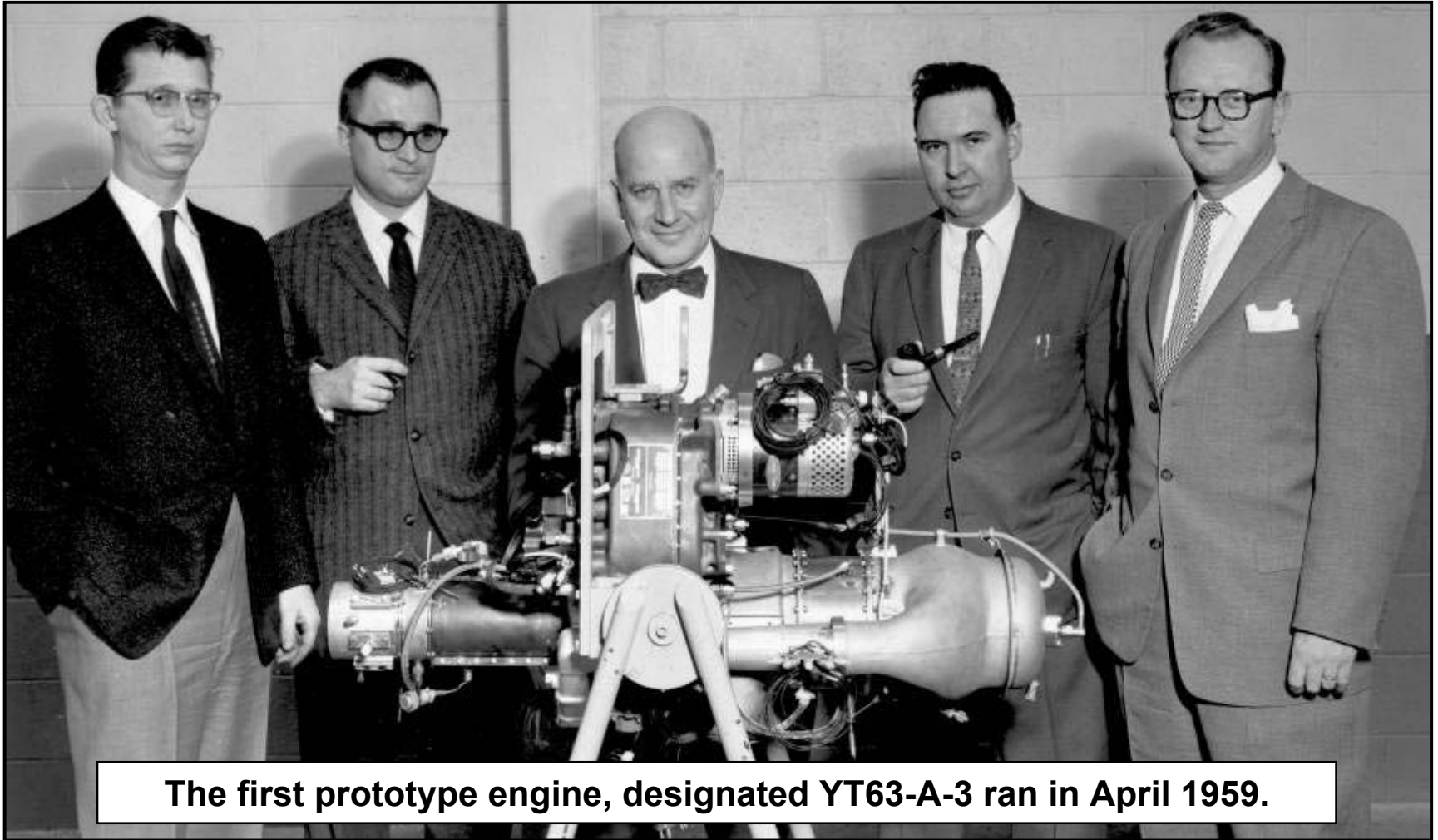


**Early M250 (T63) design evolution.
Starting to resemble today's M250**



Rolls-Royce

Birth of the Model 250 Turbine Engine

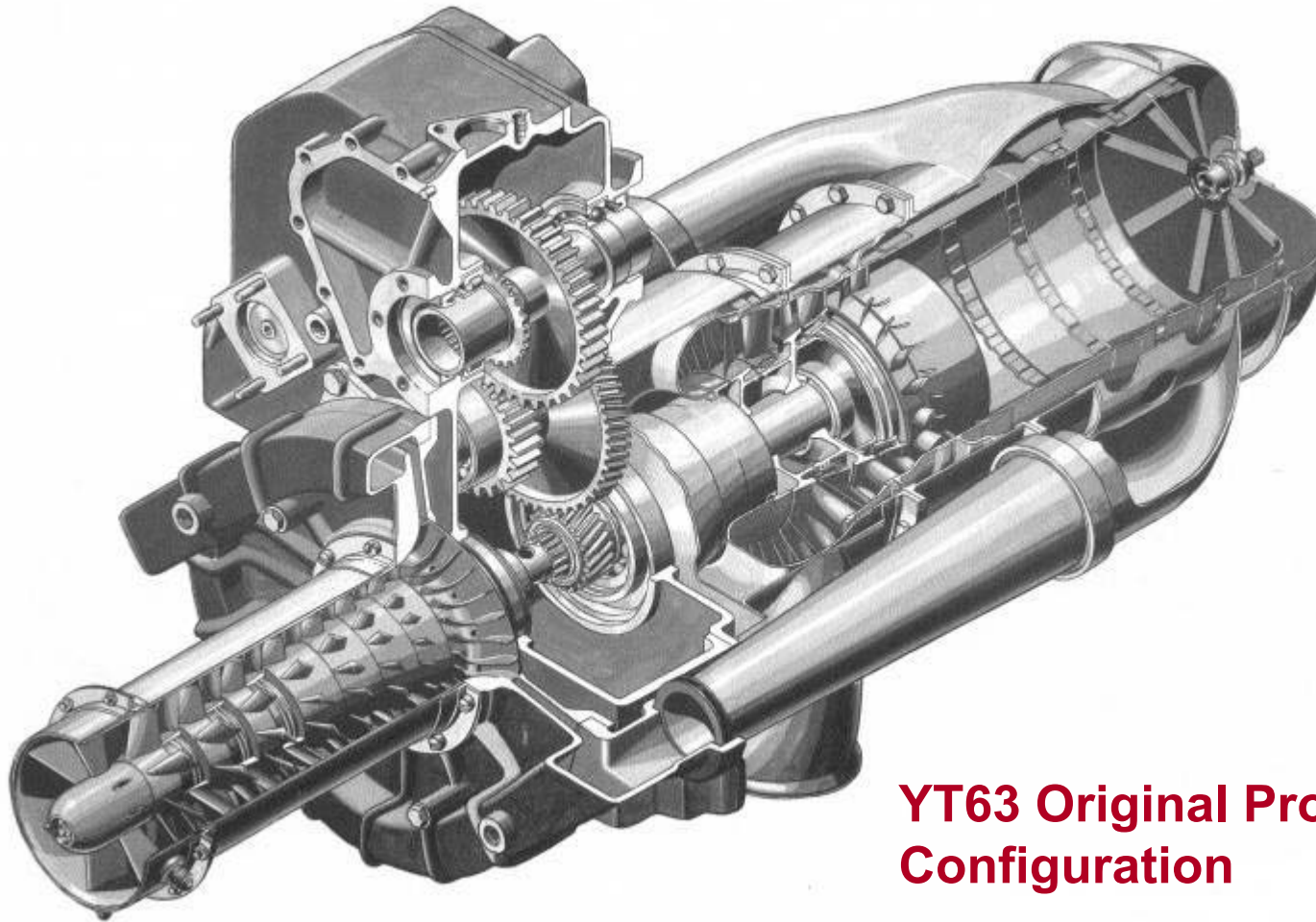


The first prototype engine, designated YT63-A-3 ran in April 1959.



Rolls-Royce

Birth of the Model 250 Turbine Engine



YT63 Original Prototype Configuration

8 stage Compressor with single stage GP Turbine & two stage PT.



Rolls-Royce

The Model 250 Turbine comes to life

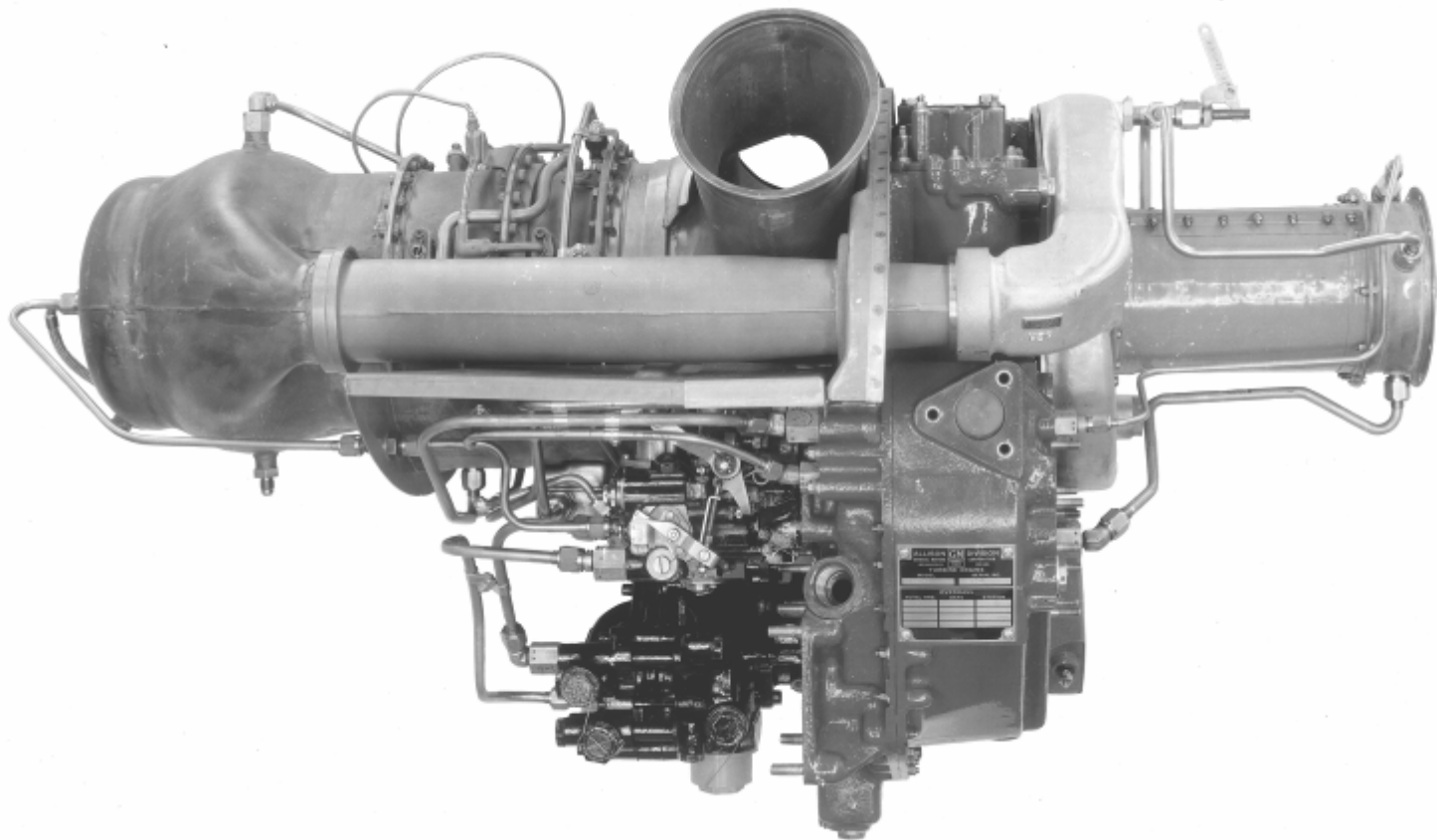
In 1960, the US Army had settled on a rotary wing platform and the YT63-A-3 first flew in a HUL-1M (a Bell 47 variant) in February 1961.



The Model 250 original design had the turbine exhaust pointing downward but to minimize IR signature and avoid accidental grass fires, Allison was asked to recertify an inverted version with exhausts pointing upward, resulting in the YT63-A-5 engine.

The Model 250 Turbine takes shape

First YT63-A-5 rated at 250 shp completed Model Qualification Testing in September 1962.



Rolls-Royce

The Model 250 Turbine Takes Flight

In 1960, the US Army launched a Light Observation Helicopter (LOH) competition.

In 1961, 3 prototypes powered by the T63-A-5 were down selected:

- Bell OH-4
- Hiller OH-5
- Hughes OH-6

In May 1965, Hughes OH-6 design was selected for the US Army LOH platform.



Above: During evaluation at Army Aviation headquarters at Fort Rucker, Alabama, the three competing LOH prototypes hover in echelon in 1963. Left to right are the Bell OH-4, the Hiller OH-5, and the Hughes OH-6.

Right: The winning Hughes Army LOH airframe made extensive use of state-of-the-art materials, design, and fabrication. Its extraordinary strength and light weight combined with superior speed and maneuverability to achieve overall excellent performance for its military mission and to affirm the basis for successful commercial adaptation.

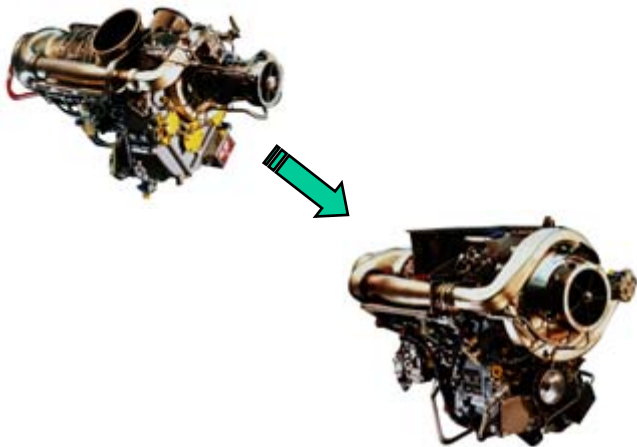


The Model 250 Turbine in Army service



The venerable OH-6 LOH has evolved over the past 40+ years of US Army service into the AH6-MELB currently still in service with the 160th Special Operations Force.

What started with 250 shp, the MELB now sports a 650 shp M250-C30R/3M.



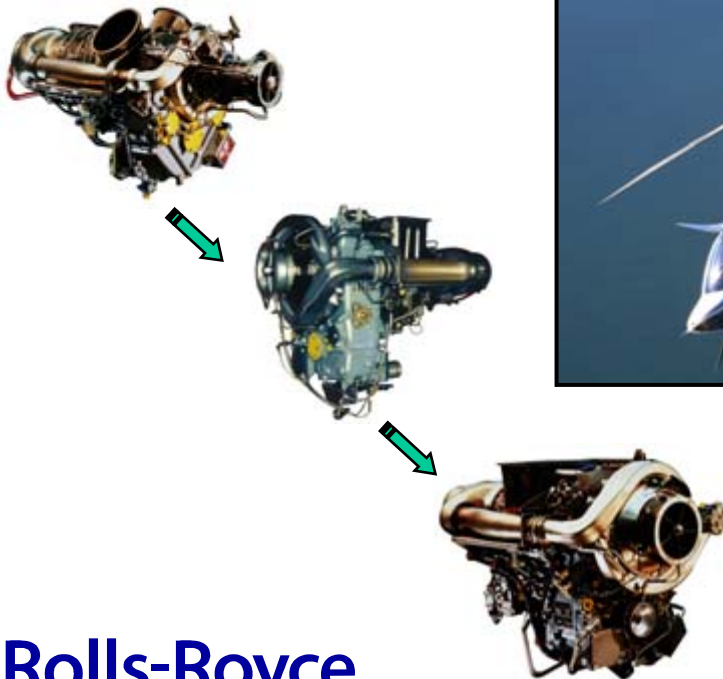
Rolls-Royce

The Model 250 Breaks into Civil service



Bell Helicopter did not take the loss of the LOH program laying down and ultimately developed its losing OH-4 into the very successful 206 and 407 light civil helicopter line. First flown in 1966, the Jetranger & Longranger series revolutionized the civil turbine helicopter industry.

Originally powered by the 317 shp M250-C18, the 206 and 407 series has incorporated every Model 250 engine series



Rolls-Royce

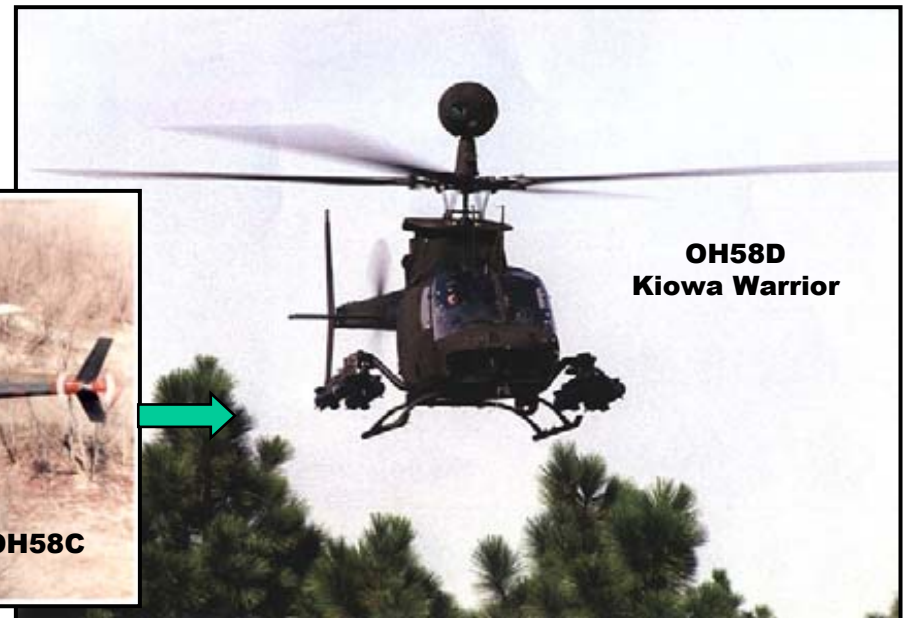
The Model 250 again captures Army LOH



In 1968, the US Army launched a second LOH competition. Bell proposed a militarized version of the JetRanger called the OH-58 Kiowa, which itself was derived from their loosing OH-4 prototype.

The Army ordered 2,200 Kiowa's in 1968.

Originally powered by the 317 shp T63-A-700, the Kiowa evolved to the 420 shp T63-A-720 then to the 650 shp T703-A-700 and ultimately to the 650 shp M250-C30R/3 FADEC equipped Kiowa Warrior.



Model 250 inspires Helicopter Conversions

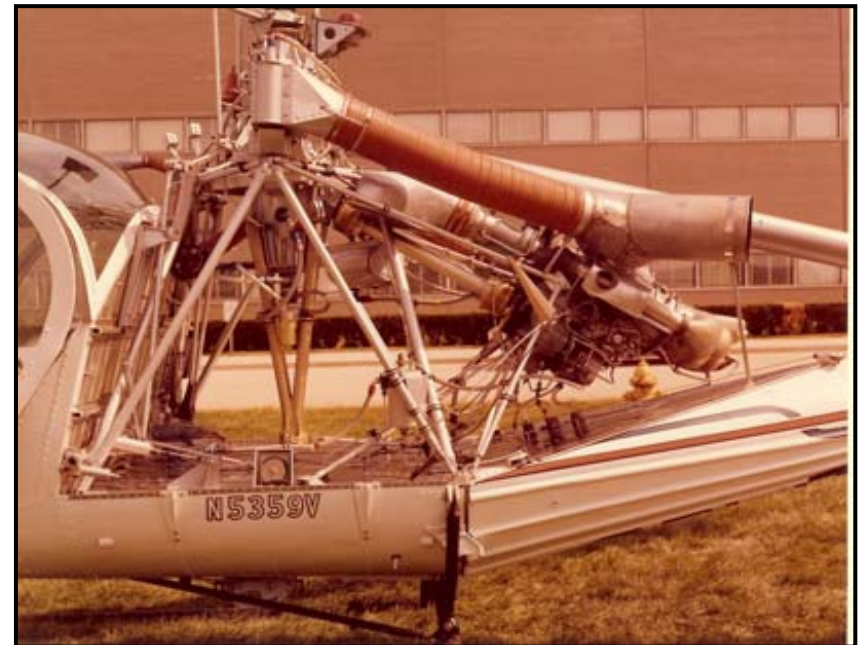
The early days of the civil utility helicopter Industry was dominated by rugged piston powered machines like the Hiller UH12E and the Bell Model 47 series.

Recognizing a opportunity to improve these workhorses, entrepreneur Joe Soloy saw the little Model 250 Turbine as the answer. Establishing Soloy Conversations Ltd. in 1969, Soloy set out to convert the Hiller UH12E to turbine, receiving his STC in 1975.



The Soloy/Hiller remains popular as a rugged light utility helicopter to this day.

The result: better Altitude Performance, Reliable Engine, Greater Useful Loads & Reduced Engine Maintenance.



Rolls-Royce

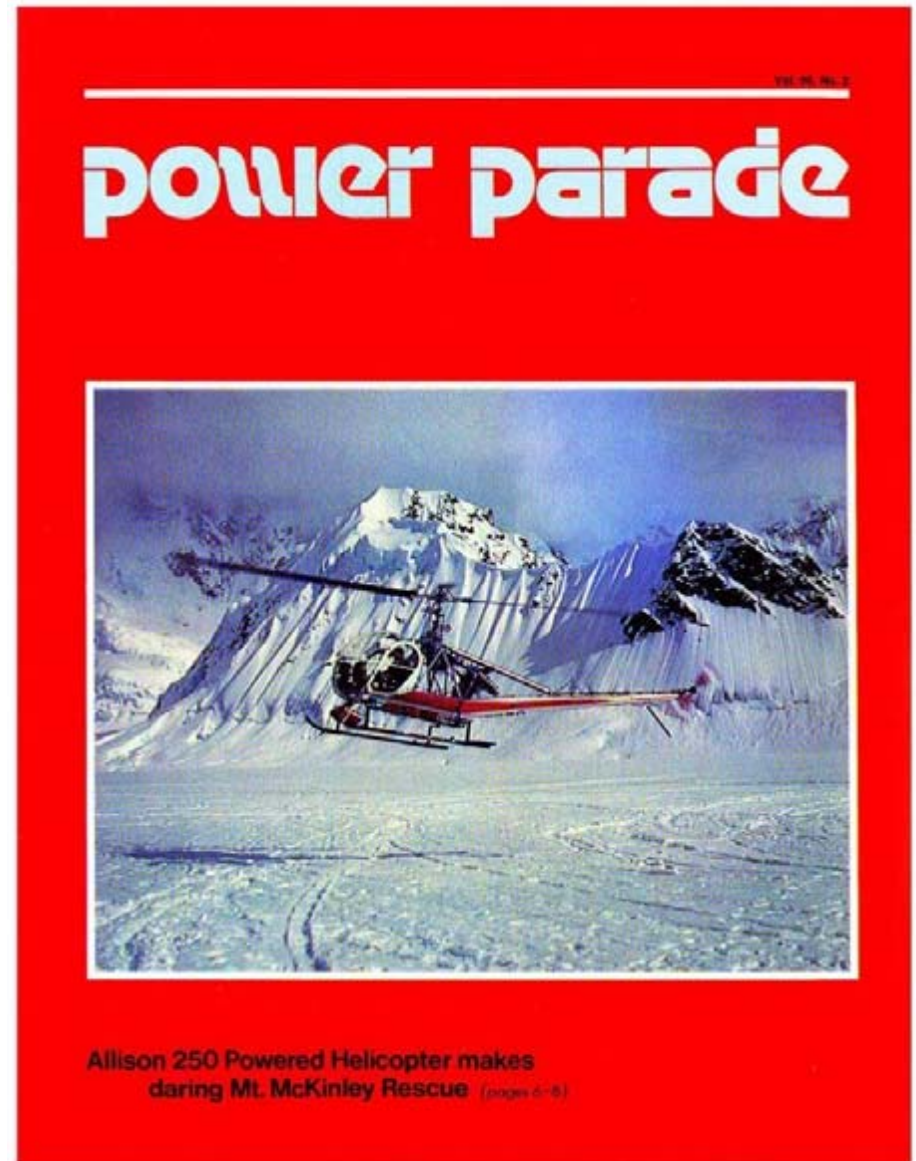
Model 250 inspires Helicopter Conversions

In May of 1977, two injured climbers became stranded near the summit of Mt. McKinley; North America's highest mountain @ 20,320'.

No Helicopter had attempted a rescue at such a height but with little hope of reaching the pair in time, a Model 250 powered Soloy/Hiller UH12E pilot volunteered to attempt the rescue.

The helicopter was certified to just 12,000' but with the M250 on board, a successful rescue was conducted with three flights to just 20' shy of the summit. Perched hovering with only one skid on a snow shelf, the worst injured climber was loaded on board.

With this, the Soloy/Hiller set an unintentional altitude record.



Rolls-Royce

Model 250 inspires Airplane Conversions

Following on the success of the Soloy/Hiller UH12E and Soloy/Bell 47 conversions, Joe Soloy turned his sights on the light airplane market.

In 1984, Soloy certified his unique “Turbine Pac” using a Model 250-C20S turbine coupled to his own Prop Reduction Gearbox. This was later certified on the Soloy/Cessna 206 & 207 models & used on numerous other experimental applications.



Development Testing of Soloy Turbine Pac with M250-C20 turbine



Certified Turbine Pac with M250-C20S turbine.



Model 250 Turboprop Applications

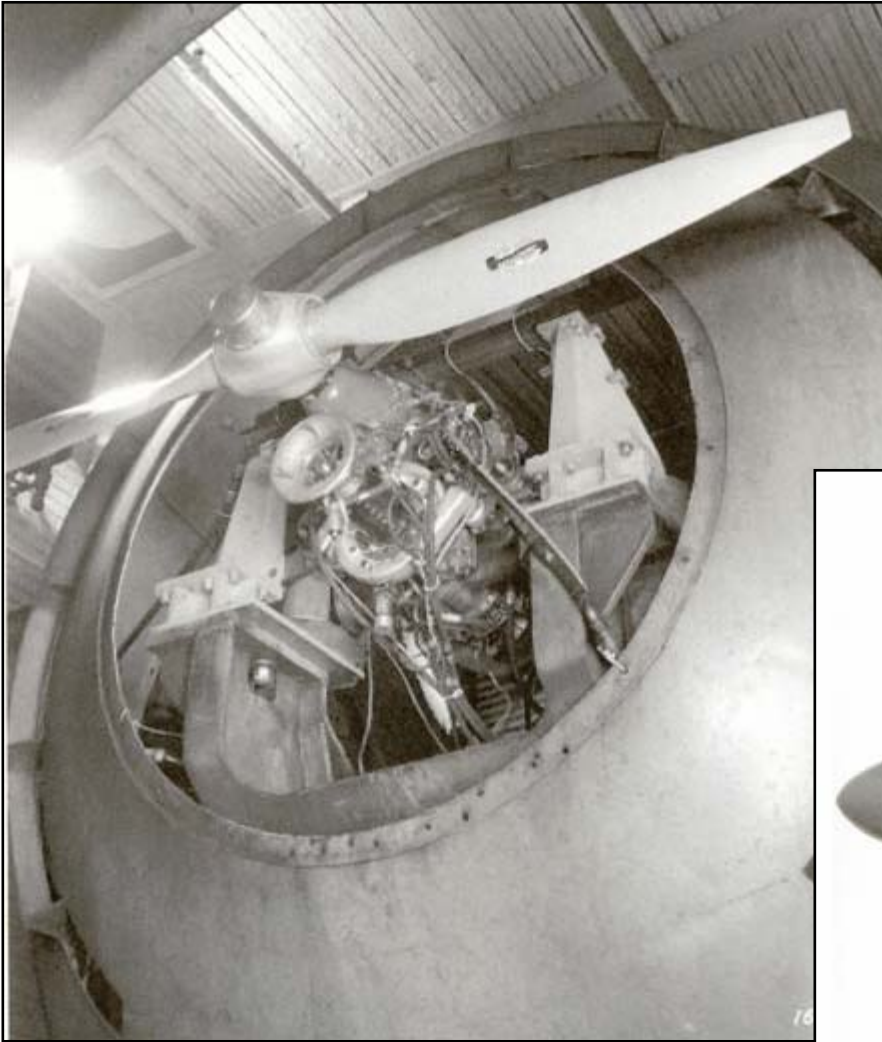
The original Model 250 design concept was to develop a turbine capable of being either a turboshaft or turboprop.

The M250-B series inverted the turboshaft engine and added a prop reduction gearbox to become a popular light turboprop.



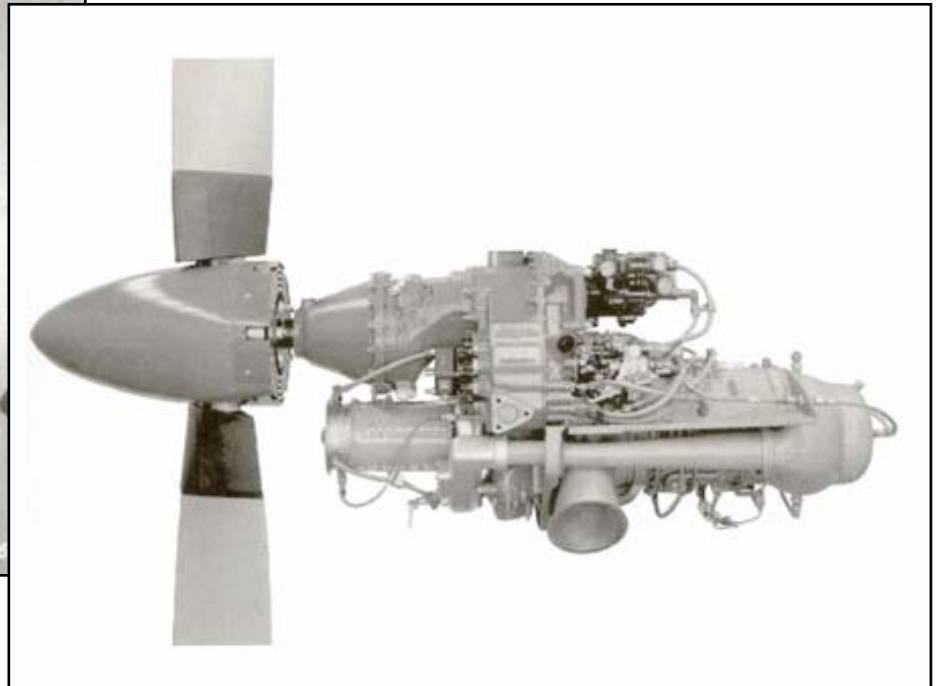
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Model 250 Turboprop Applications



Early development testing of the T63 turboprop engine began in the mid 1960's. In March 1969 the first turboprop derivative was certified; the 317 shp Model 250-B15.

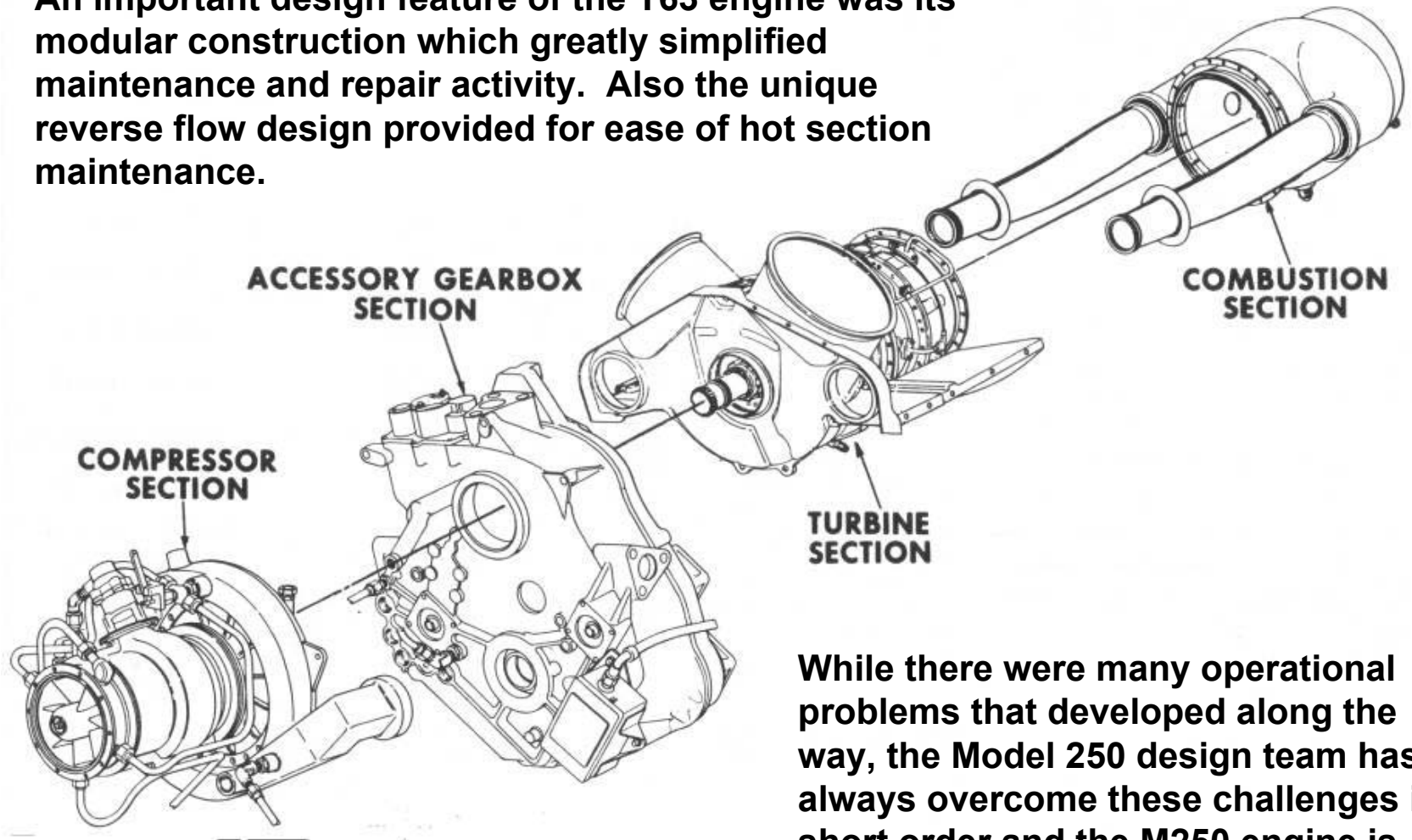
The first application for the B15 was the Siai Marchetti SM-1019, a turbine derivative of the Cessna 0-1A Bird Dog.



Rolls-Royce

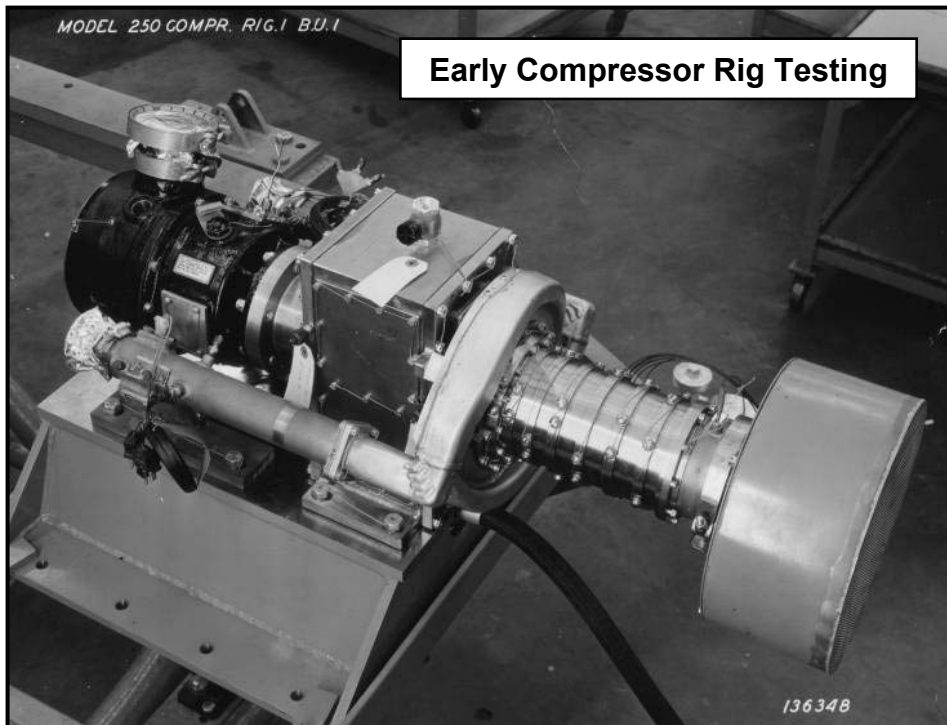
Rolls-Royce Model 250 Turbine Design

An important design feature of the T63 engine was its modular construction which greatly simplified maintenance and repair activity. Also the unique reverse flow design provided for ease of hot section maintenance.



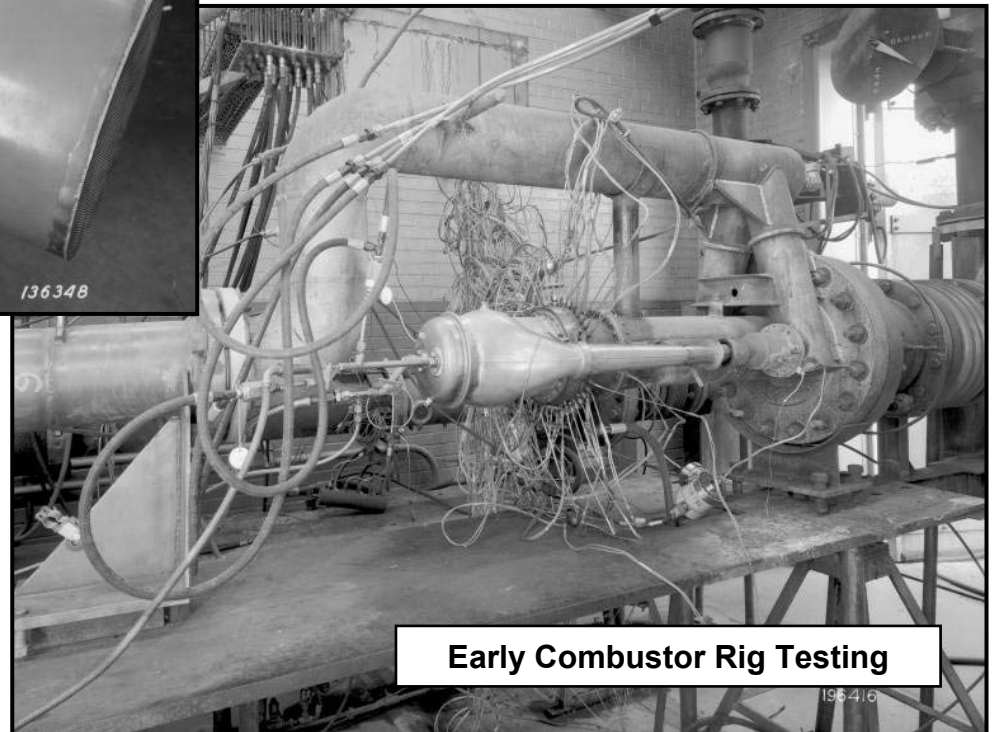
While there were many operational problems that developed along the way, the Model 250 design team has always overcome these challenges in short order and the M250 engine is regarded as highly reliable.

Rolls-Royce Model 250 Turbine Engine



From early development activity throughout its 45+ year life span, the Model 250 family has seen nearly continual extensive test activity to both improve reliability and grow the power range.

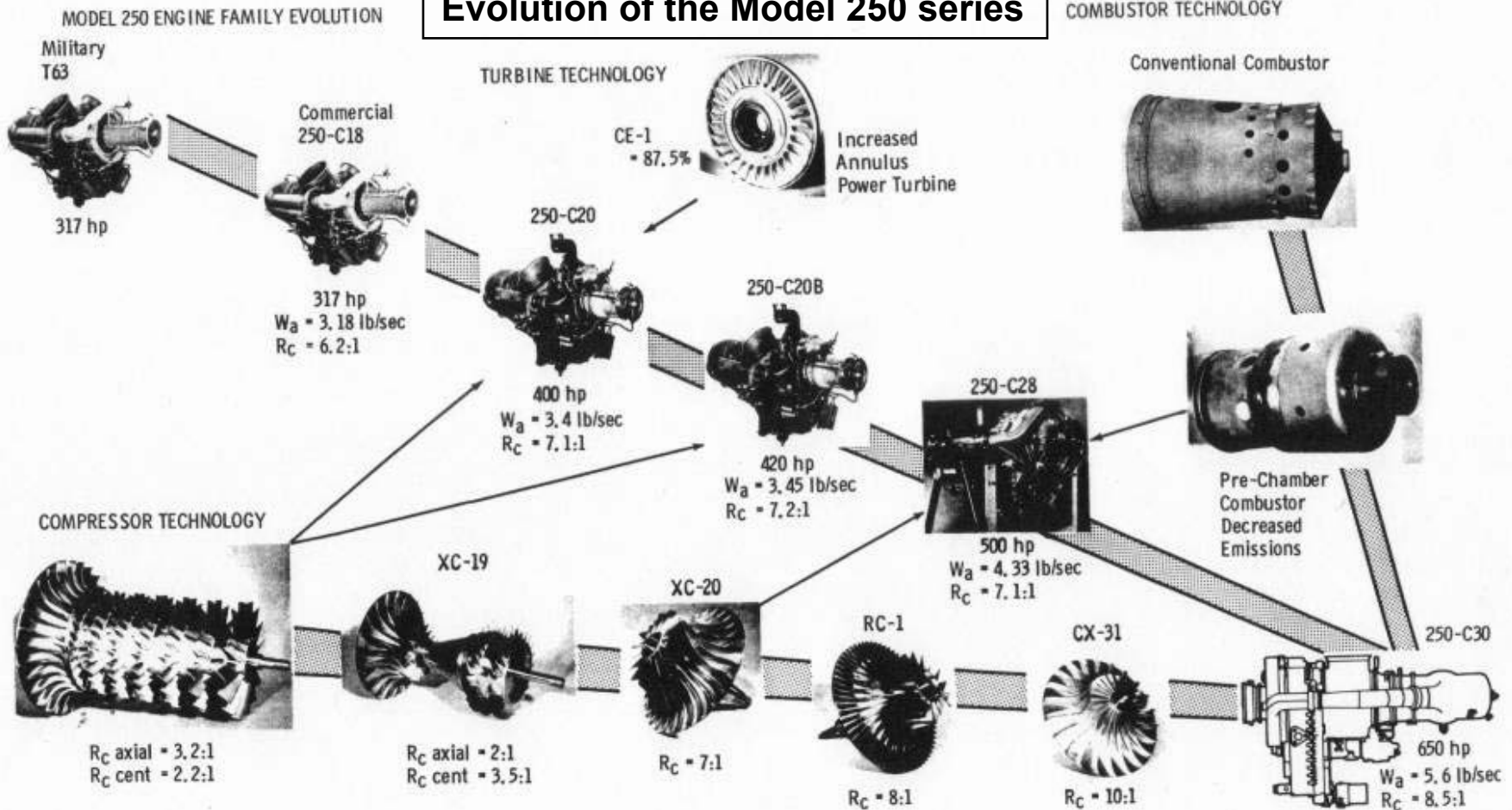
- Prototype engine 250 shp
- Series 1 317 shp
- Series 2 400-450 shp
- Series 3 500 shp
- Series 4 650-715 shp



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

Evolution of the Model 250 series



312965



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

Evolution of the Model 250 series;

Series I:

- T63-A-5 (civil designation M250-C10), rated @ 317 shp, certified in 1962.
- T63-A-700 (civil designation M250-C18), rated @ 317 shp, certified in 1965.
 - Offered full thermodynamic rating structure and improved TBO (750 hrs)
- Model 250-B15 turboprop rated @ 317 shp, certified in 1969.
- A total of 6,410 series I turboshafts and 95 series I turboprops were produced.

Series II:

- M250-C20 (Military T63-A-701), rated @ 400 shp, certified in 1970.
- M250-B17 turboprop rated @ 400 shp, certified in 1971.
- M250-C20B (Military T63-A-720), rated @ 420 shp, certified in 1974.
- M250-B17B turboprop rated @ 400 shp, certified in 1974. (limited by PRGB)
- M250-B17B turboprop rated @ 420 shp, certified in 1979. (improved PRGB)
- M250-C20R rated @ 450 shp, certified in 1986 featured improved compressor.
- M250-B17F rated @ 450 shp, certified in 1988 featured improved compressor.



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

Evolution of the Model 250 series;

Series III:

- **M250-C28 rated @ 500 shp, certified in 1976 featured single stage centrifugal compressor with beefed up gearbox & turbine airflow improvements.**
- **M250-C28B rated @ 500 shp, certified in 1978 featuring improvements in compressor, combustor & turbine airflow.**
- **A total of 936 series III engines were produced.**

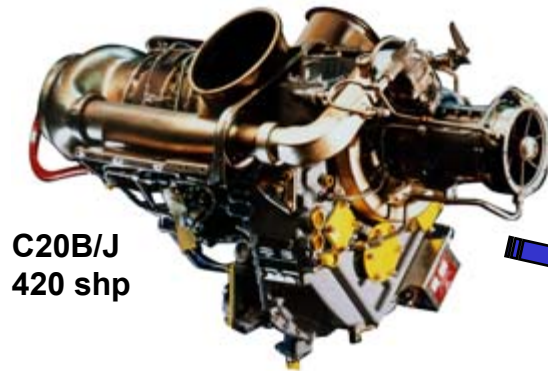
Series IV:

- **M250-C30 series rated @ 650 shp, certified in 1978.**
- **M250-C30R (Military T703-A-700), rated @ 650 shp, certified in 1983 featured a electronic supervisory fuel control system.**
- **M250-C40 & C47 (Military M250-C30R/3)), rated @ 650 shp, certified in 1996 features improved compressor airflow, air cooled turbine nozzle, low smoke combustor & a Full Authority Digital Engine control system (FADEC).**

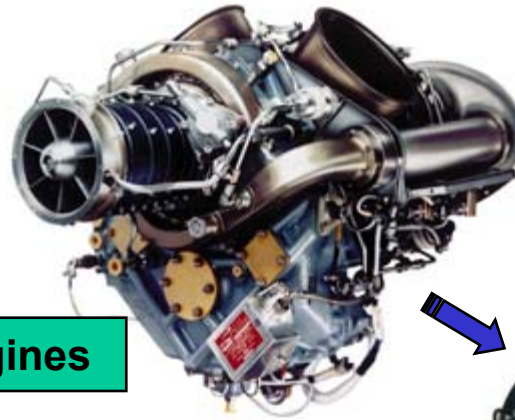


Rolls-Royce

Rolls-Royce Model 250 Turbine Engine



C20B/J
420 shp



C20R/B17F
450 shp



C30P
650 shp



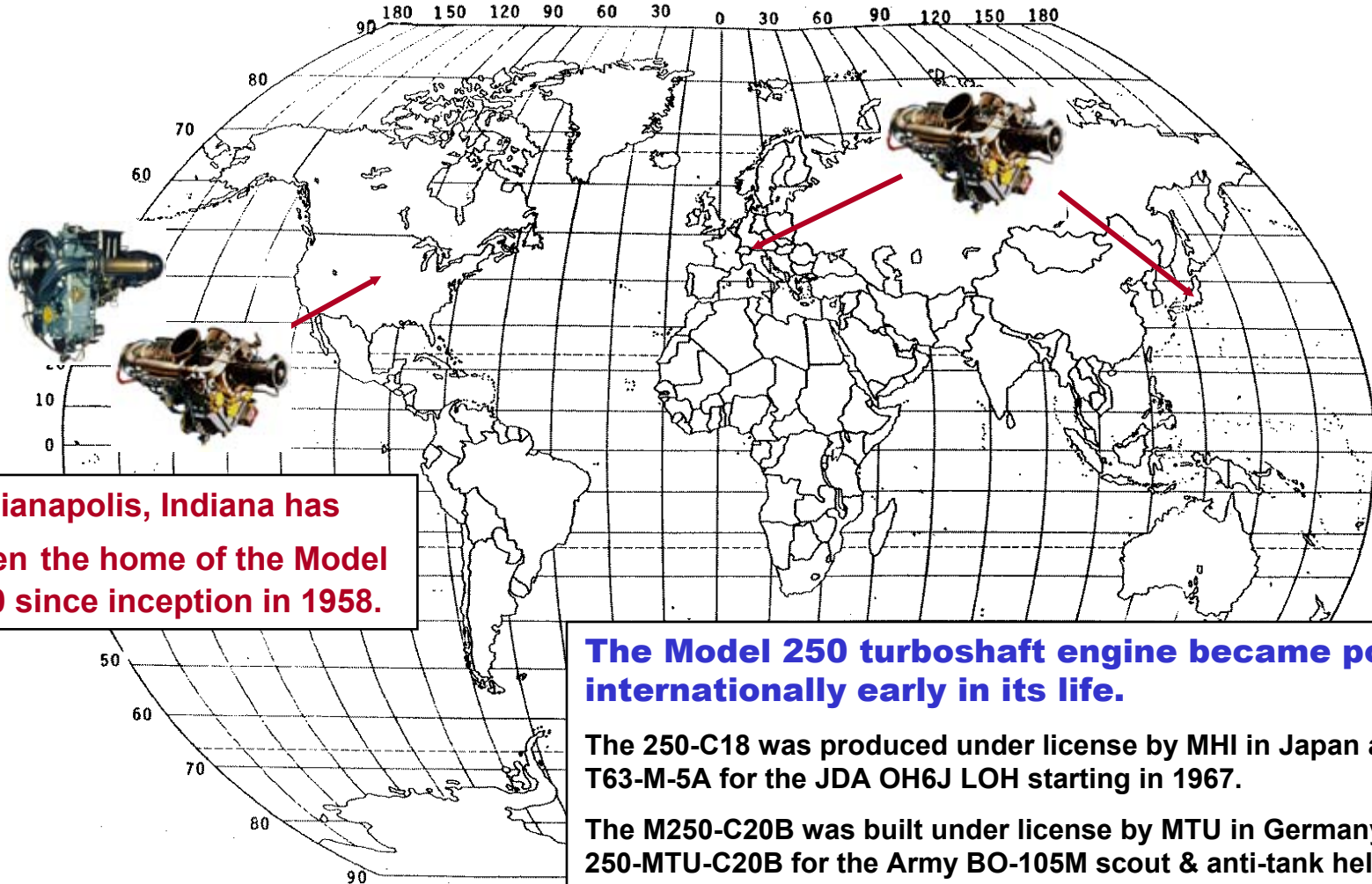
C47B
650 shp
FADEC

Current Production Model 250 Engines



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine



Indianapolis, Indiana has been the home of the Model 250 since inception in 1958.

The Model 250 turboshaft engine became popular internationally early in its life.

The 250-C18 was produced under license by MHI in Japan as the T63-M-5A for the JDA OH6J LOH starting in 1967.

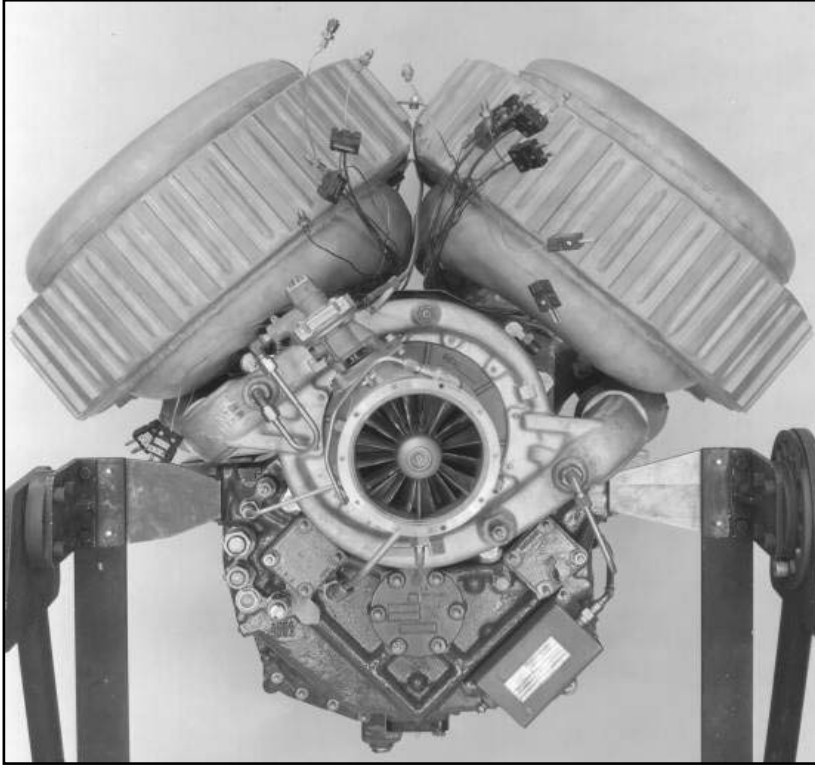
The M250-C20B was built under license by MTU in Germany as the 250-MTU-C20B for the Army BO-105M scout & anti-tank helicopter variants starting in 1973.

In 1967, Allison signed a distribution agreement with Rolls-Royce although no engines were ever produced in the UK.



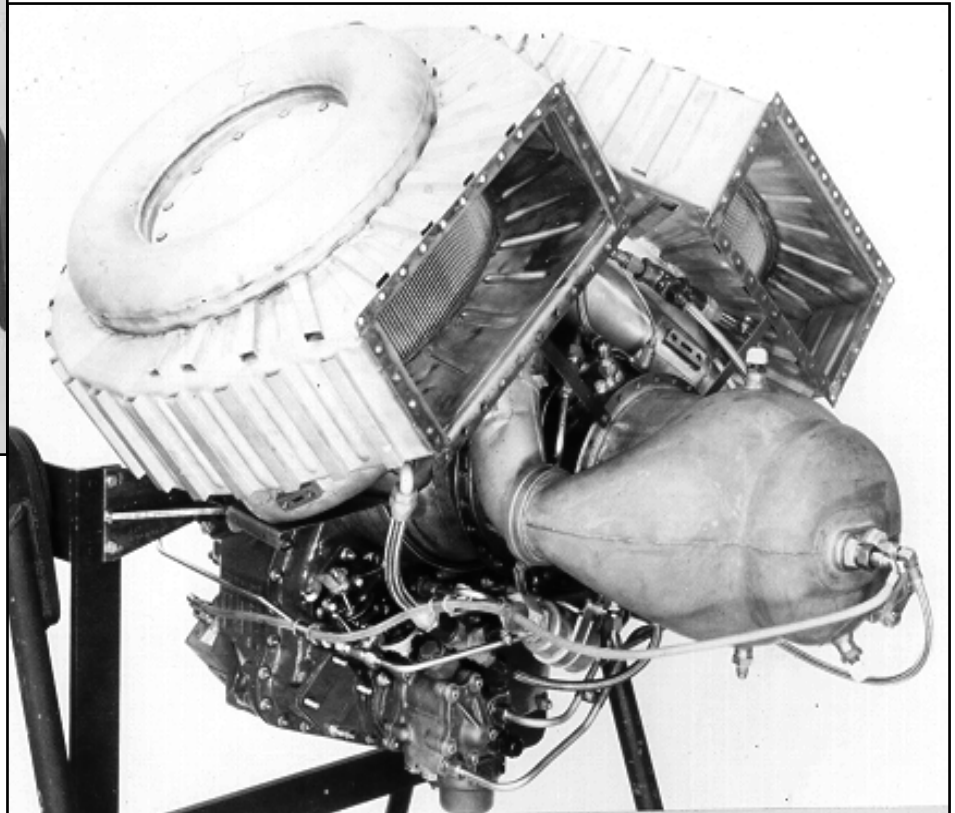
Rolls-Royce

Rolls-Royce Model 250 Turbine Engine



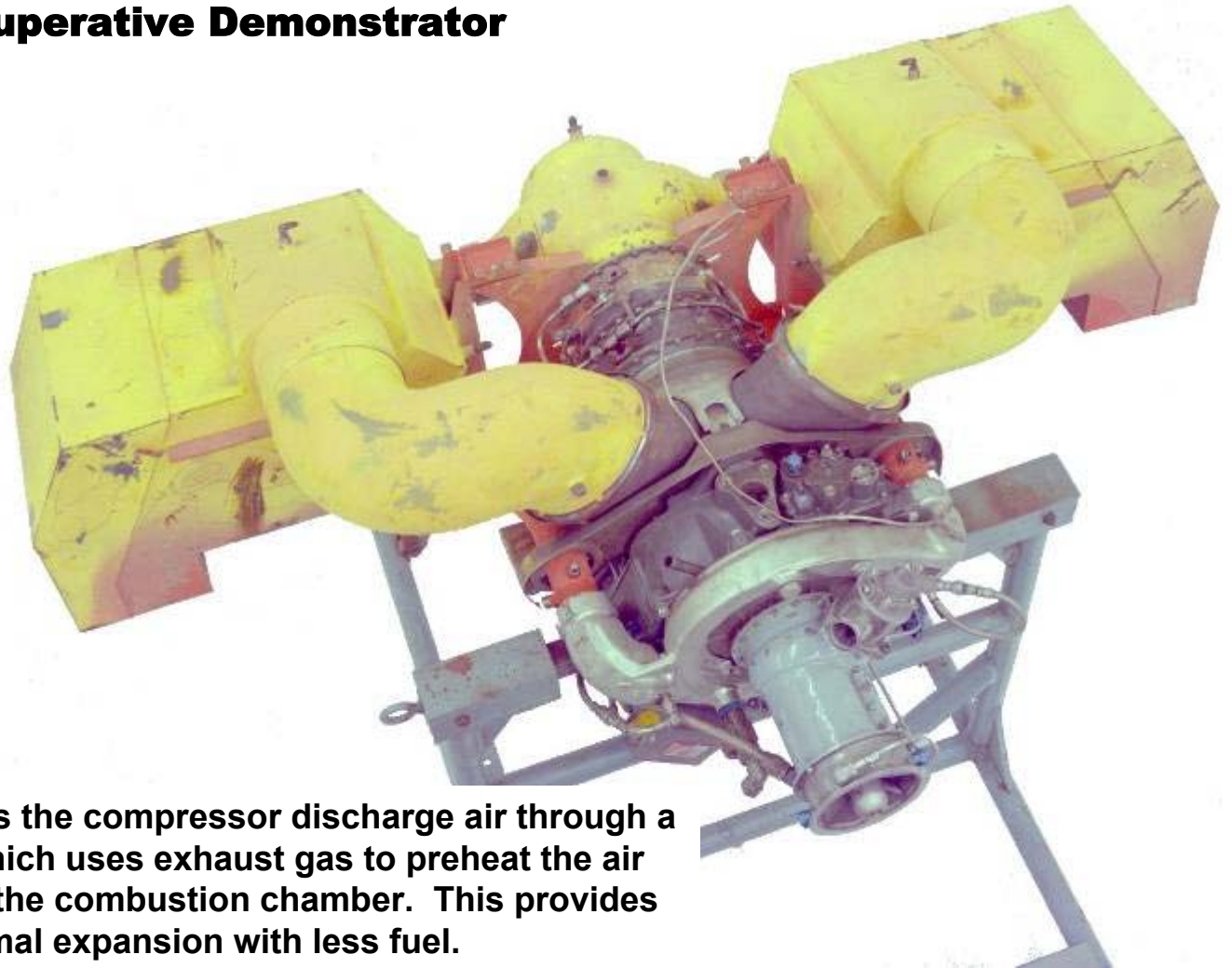
Along the way, many weird and wonderful concepts have been tried out on the little Model 250 engine. This is an early attempt at a recuperative concept targeted at significant fuel consumption reduction.

Model 250 Recuperative concept testing



Rolls-Royce Model 250 Turbine Engine

**Another Recuperative Demonstrator
Concept.**

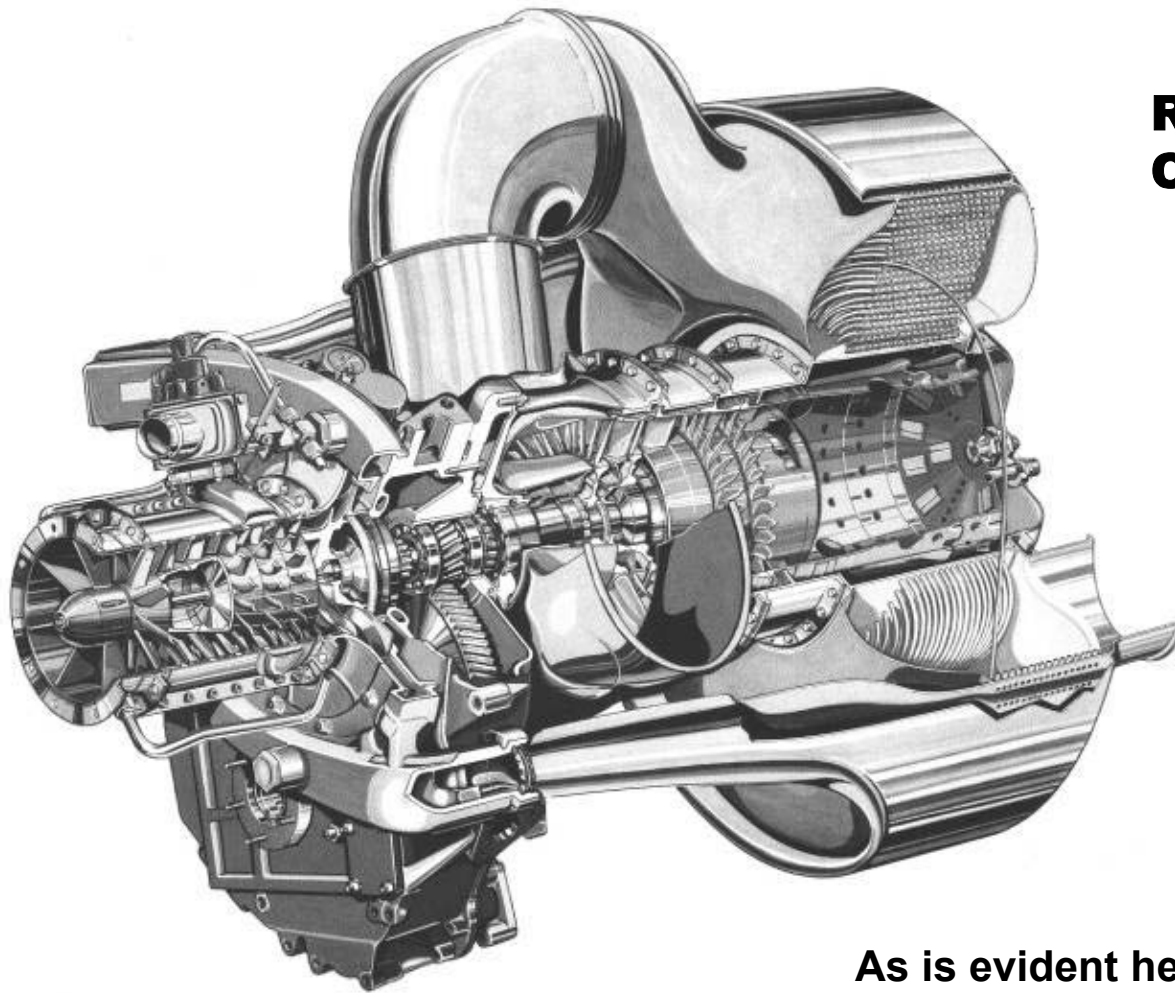


Recuperation ports the compressor discharge air through a heat exchanger which uses exhaust gas to preheat the air before delivery to the combustion chamber. This provides a measure of thermal expansion with less fuel.



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine



**Recuperative
Concept Engine**

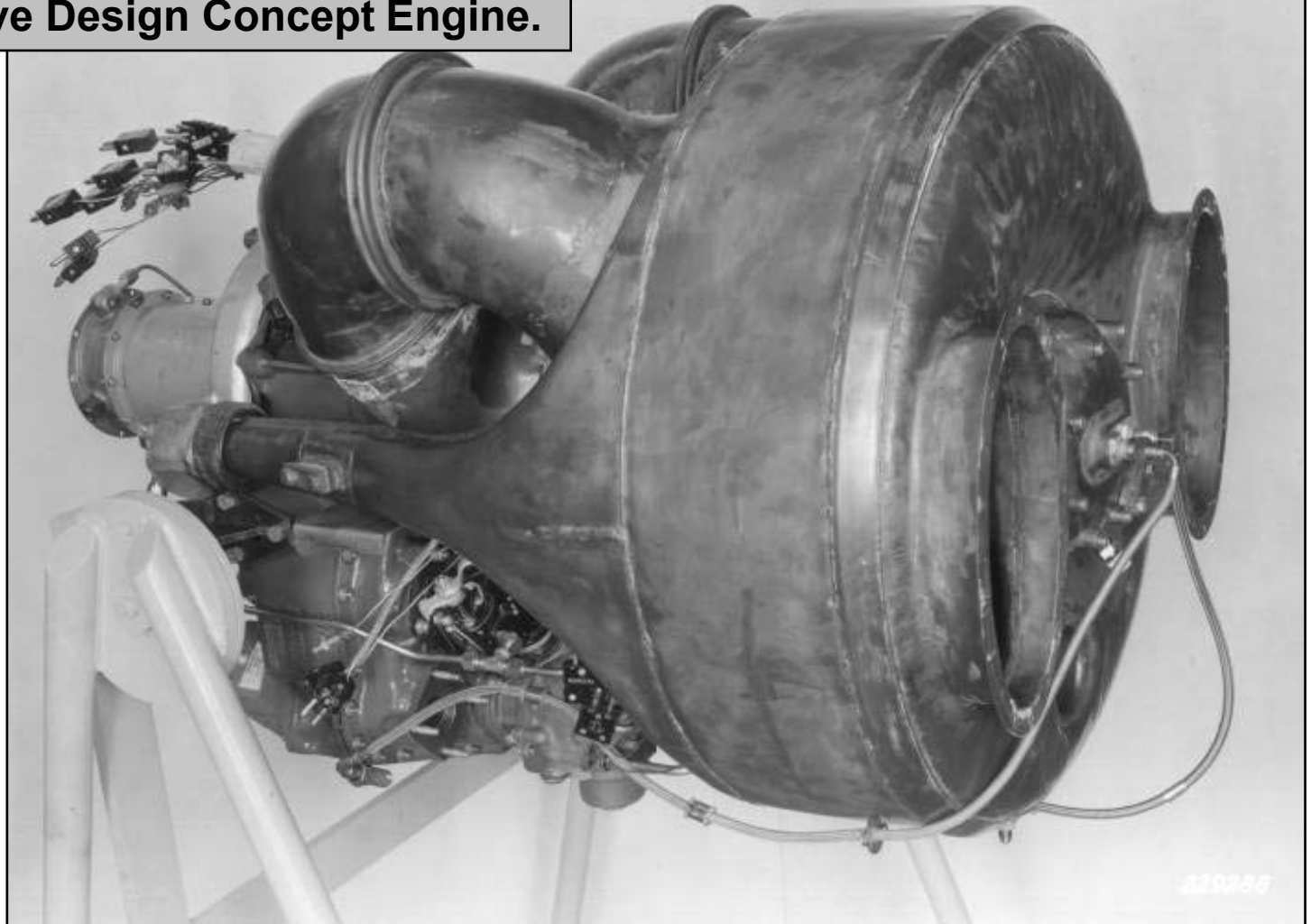
**As is evident here, the system size
and weight prevented viable
introduction into light helicopters.**



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

Recuperative Design Concept Engine.



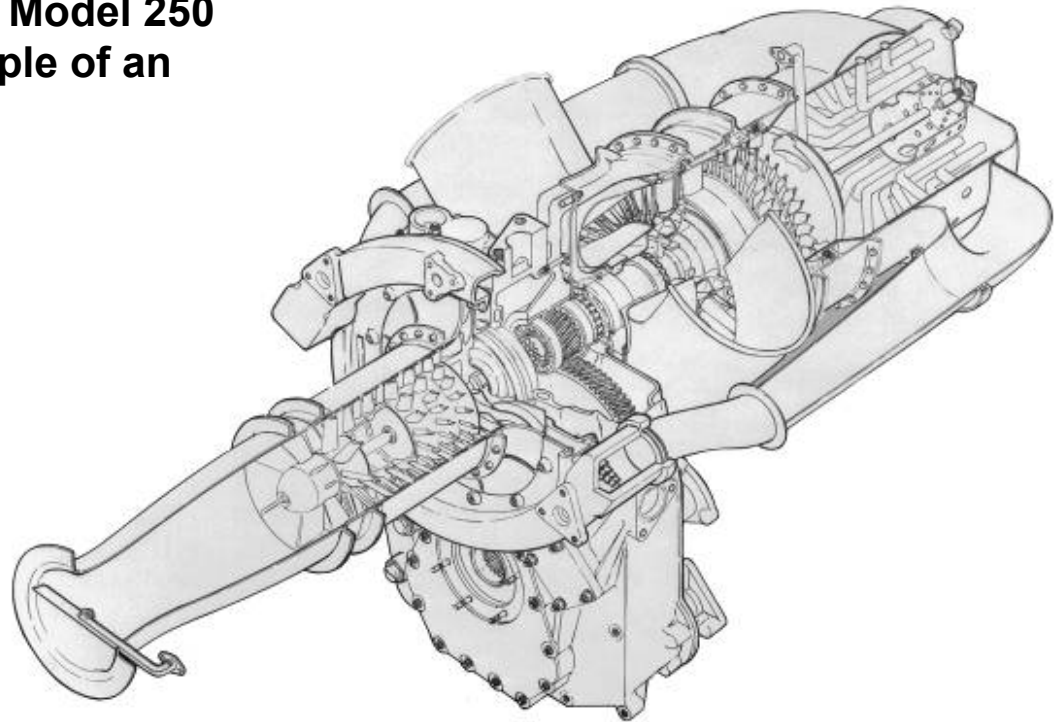
Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

**TURBOSHAFT ENGINE
NH₃ FUEL**

460 BHP

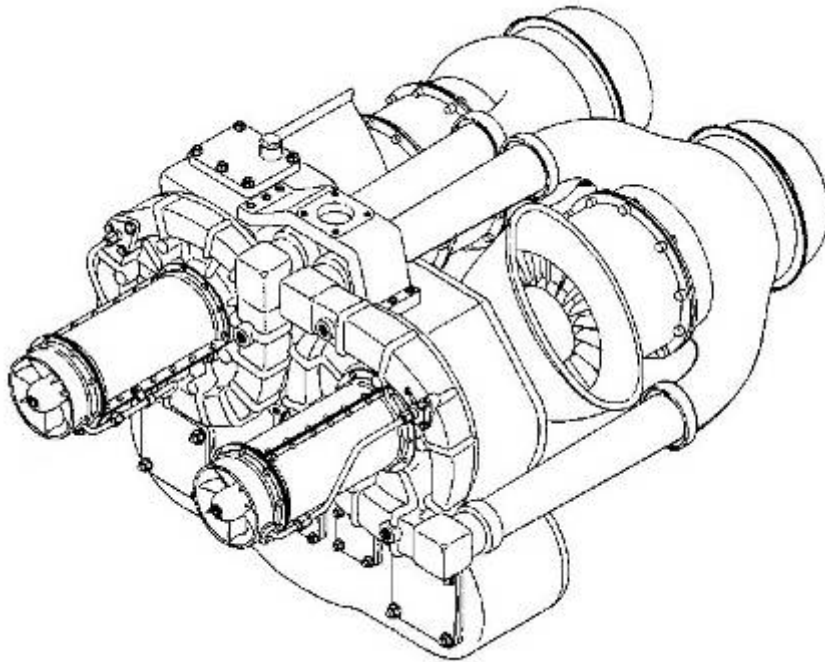
Alternative fuels were also experimented with on the Model 250 engines. This is an example of an Ammonia fueled engine.



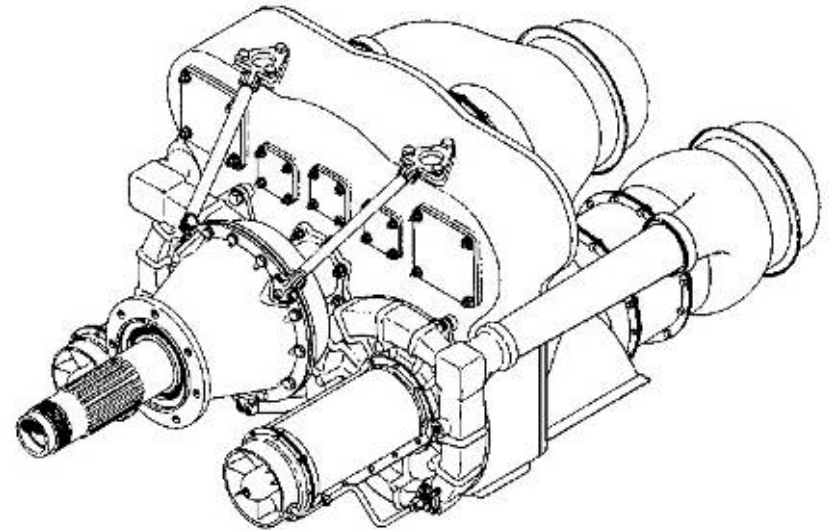
Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

To satisfy increased power demands and twin engine safety concerns, Allison explored **Coupled Engine Concepts**; which mounted two engine cores onto a common gearbox. Two versions were explored: Turboshaft and turboprop.



Turboshaft



Turboprop

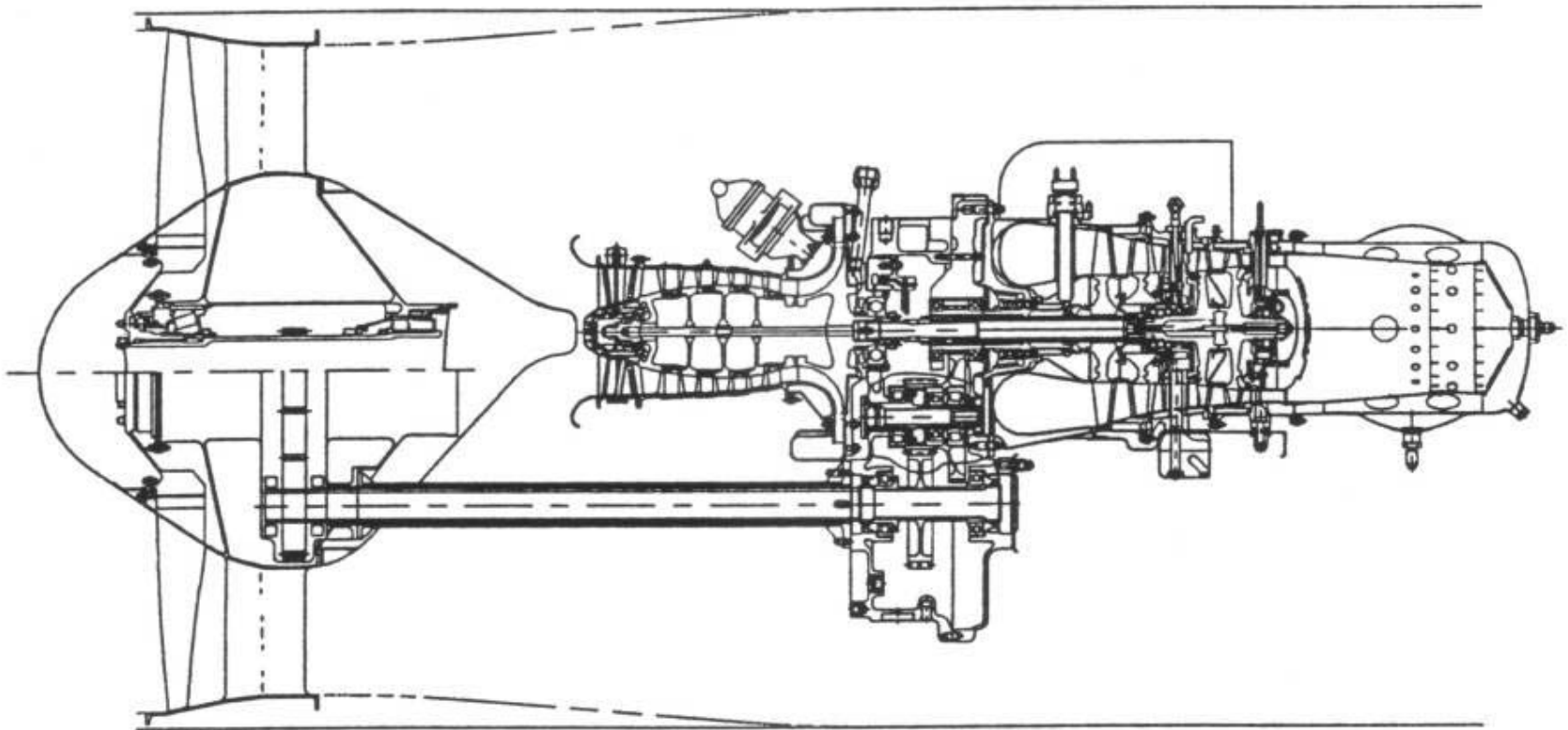


Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

Back to the weird and wonderful, there are not many concepts that have not been looked at for the Model 250 family.

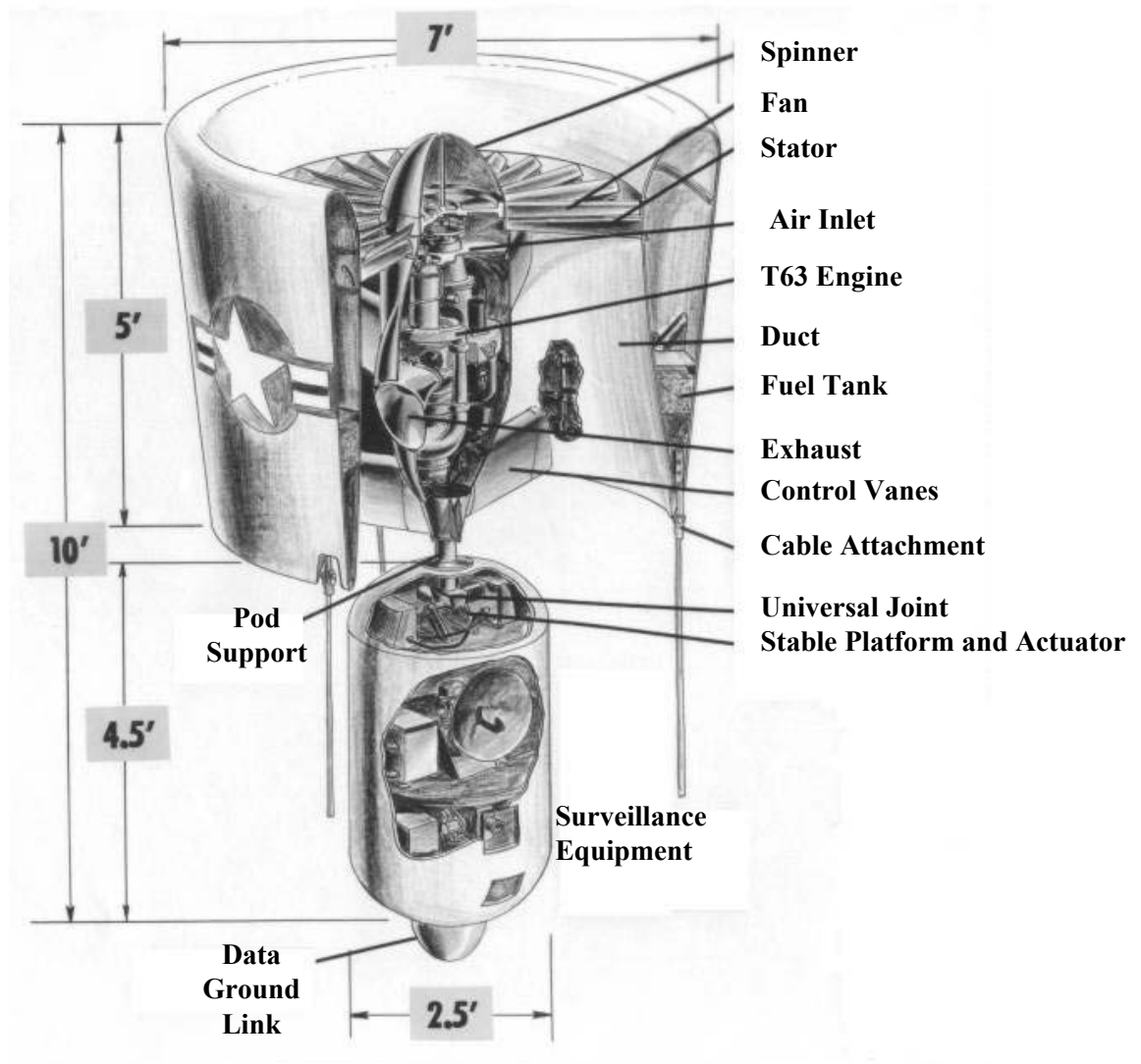
Pictured here is a Turbofan concept.



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine

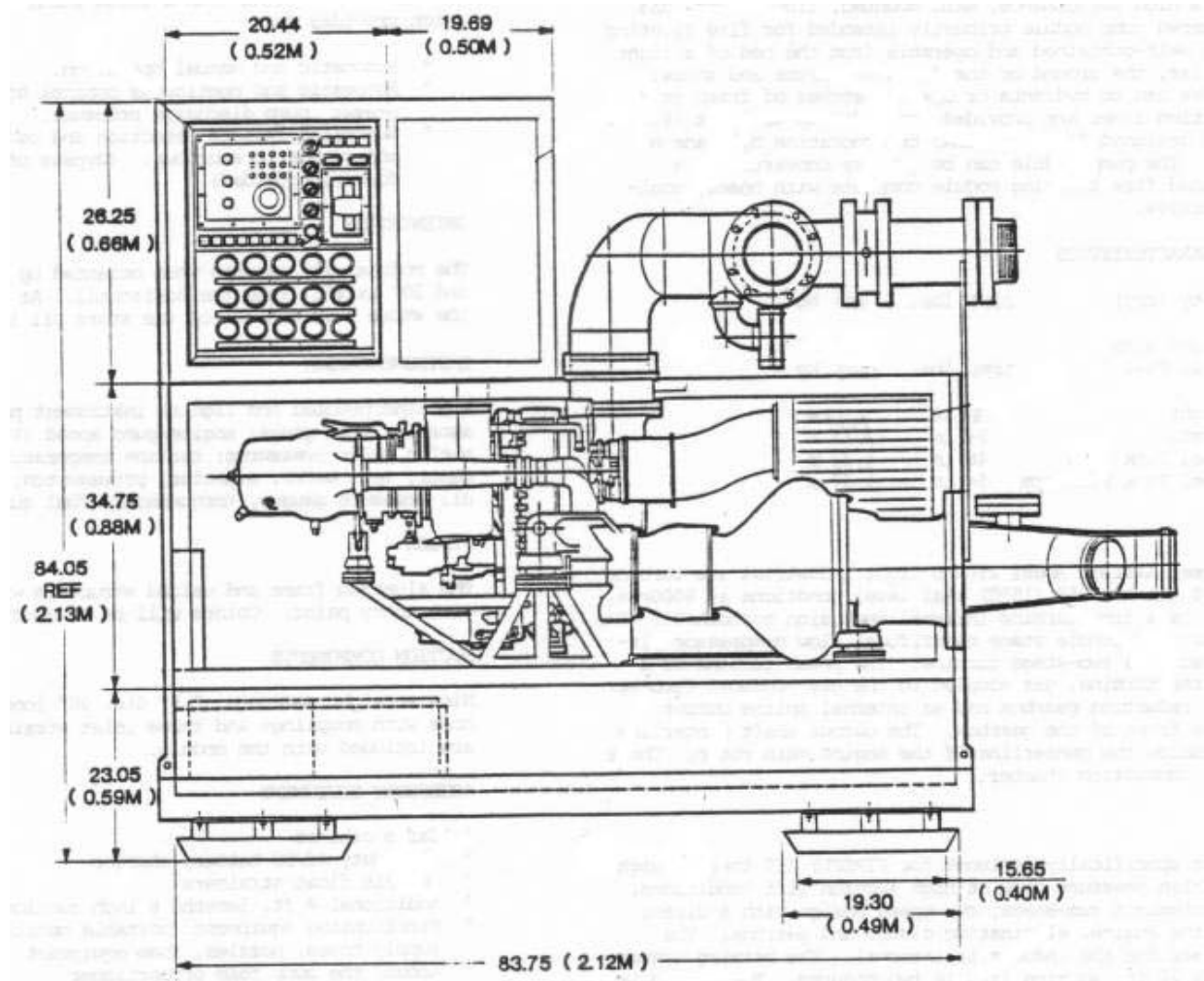
Another concept that never saw the light of day was the **Totem Surveillance System.**



Rolls-Royce Model 250 Industrial Turbine

The Model 250 did see several successful non-aviation applications.

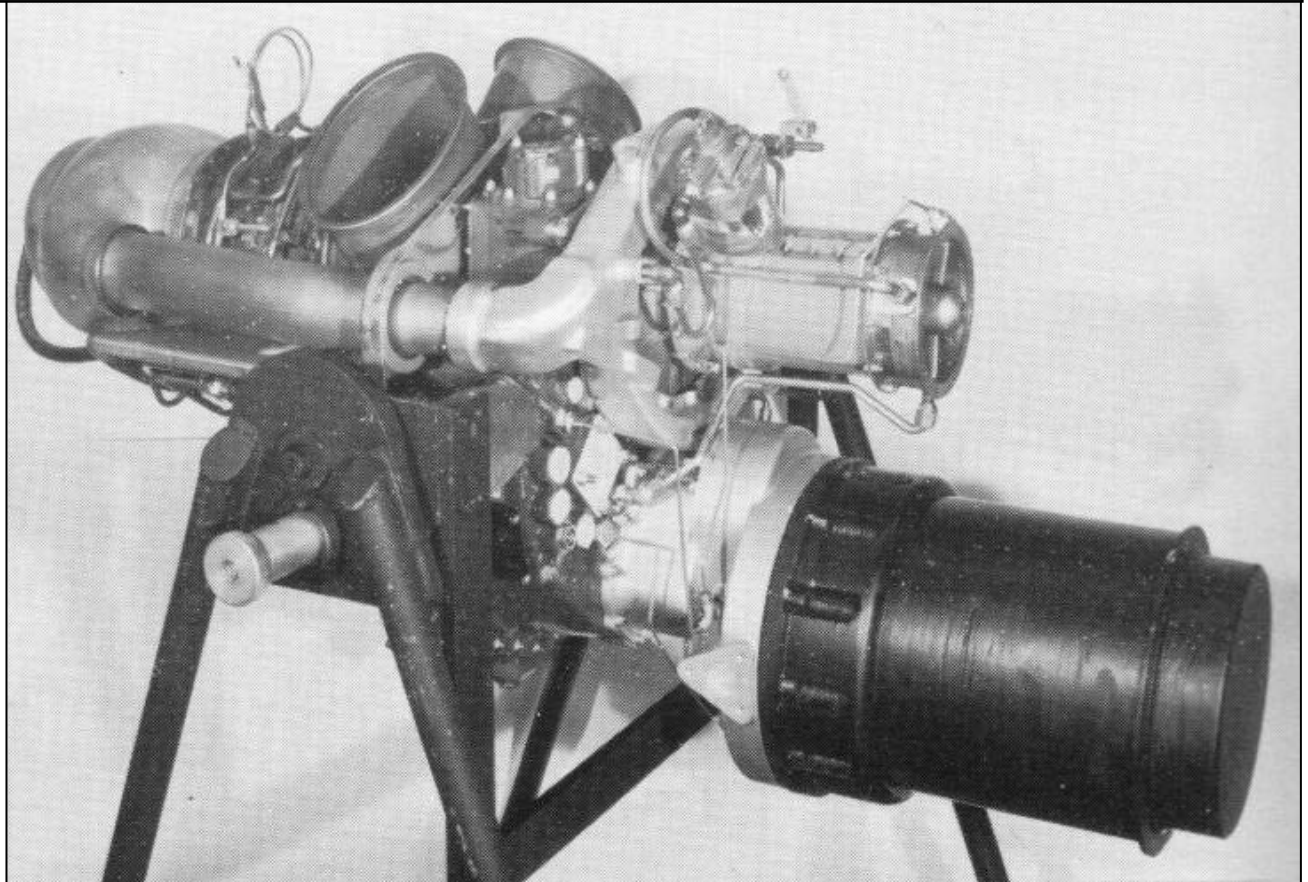
Pictured here is the Firefly water pump system powered by a M250-C30 engine.



Rolls-Royce

Rolls-Royce Model 250 Industrial Turbine

The Model 250KS4 series was successfully adapted to industrial and marine life as a starter system onboard some US Navy AEGIS ships. Marinization of the engine included replacement of magnesium components with aluminum.



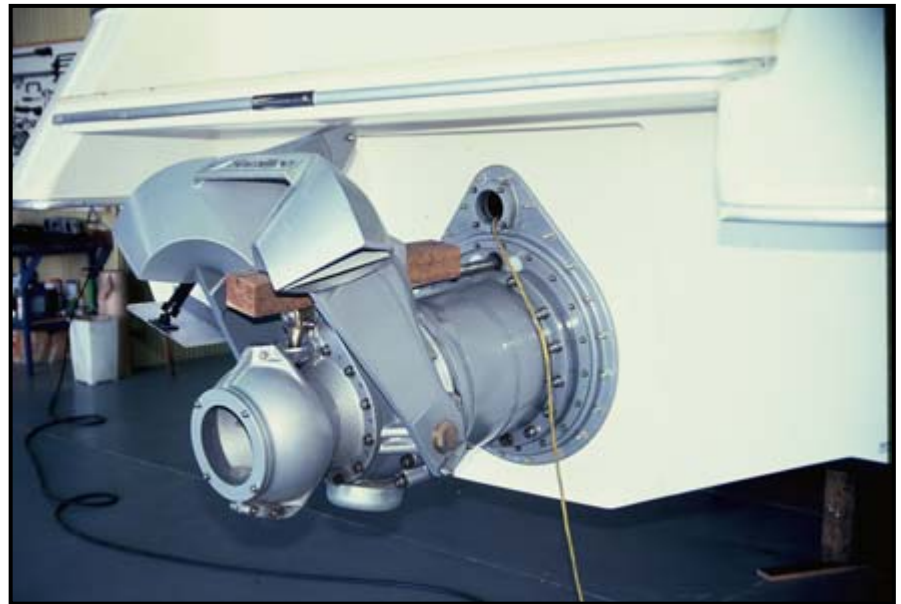
Rolls-Royce

Rolls-Royce Model 250 Marine Turbine



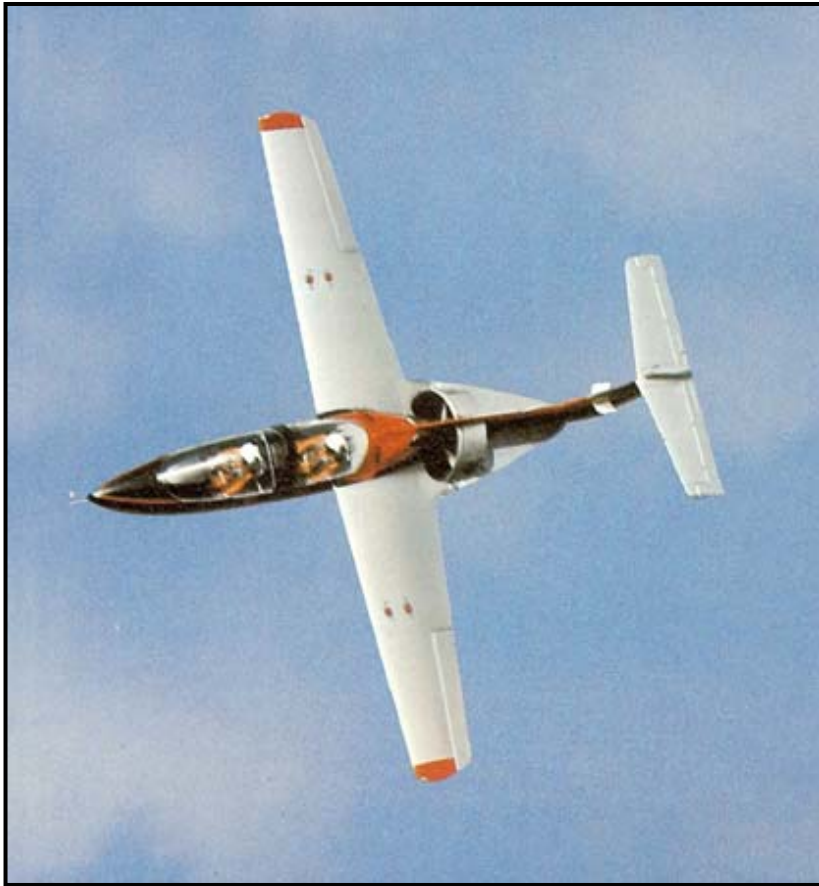
In more recent years, the Model 250 has been tapped for Marine propulsion and other non-aviation systems.

Picture here is a pair of M250-C30 engines driving a powerful 1,300 shp water jet propulsion system.



Rolls-Royce

Rolls-Royce Model 250 Turbine Engine



Some unusual Model 250 powered aircraft installations include:

RFB FanTrainer

Goodyear Blimp

Groen GyroPlane



Rolls-Royce

Rolls-Royce Model 250 for the future

The little Model 250 turbine continues to be selected for unique applications



MQ-8B Fire Scout



Rolls-Royce

Rolls-Royce Model 250 World Records

Model 250 powered helicopters currently hold 150 FAI-recognized world records. These include no less than four around the world records and a pole-to-pole circumnavigation.

- In 1966, Hughes Test Pilot Robert Ferry made a record 2,213 mile non-stop solo coast-to-coast flight in an YOH-6A helicopter from Culver City, CA to Ormond Beach, FL.
- In 1982, Ross Perot Jr. & Jay Coburn completed the first around-the-world helicopter flight in a Bell 206L1 Longranger II.
- In 1983, Australian millionaire Dick Smith made the first SOLO around-the-world helicopter flight in a Bell 206 Jetranger II.
- In 1994, Joe Bower set the speed record for east-bound around-the-world rotorcraft flight in a Bell 206 Jetranger III.
- In 1996, Joe Bower & John Williams established the speed record for a west-bound rotorcraft flight in the newly certified FADEC equipped Bell 430.
- In 2007, Jennifer Murray & Colin Bodill established the record for a Pole-to-Pole circumnavigation in a FADEC equipped Bell 407.



Rolls-Royce

Rolls-Royce Model 250 Next Generation

RR300



The future continues to look bright for the little Model 250 Turbine with the recent launch of the next generation; the RR300 & RR500.

These new variants are infused with modern production techniques and materials to continue the heritage

RR500TP



Rolls-Royce

Rolls-Royce Model 250 next Generation



**The Model 250 Turbine Engine Family;
50 years young and still going strong!**



Rolls-Royce